The genus Banksia L.f. (Proteaceae)

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Abstract

George, A. S. The genus *Banksia* L.f. (Proteaceae). Nuytsia 3(3): 239–474 (1981).

The genus *Banksia* L.f. is revised according to classical taxonomic principles. The genus contains 71 species, of which 10 are described as new; 2 previously described as varieties are re-described as species; new epithets are provided for 2 names which were later homonyms; 2 species are reduced to varietal rank; and 9 new varieties are described. Fifty seven species are endemic in South West Western Australia and adjacent regions; 13 occur in eastern Australia from north Queensland to Eyre Peninsula and Tasmania; and one extends across tropical Australia and into southern Papua-New Guinea, Irian Jaya and the Aru Islands. A new infrageneric classification of the genus is proposed, including the description of 6 new series. All taxa are fully described; distribution, habitat and flowering period are given. A key to species and infraspecific taxa is provided. The major steps in the historical progress of the taxonomy of *Banksia* are outlined. The morphology is discussed, including that of seedlings. All names published under *Banksia* are listed with an indication of their status.

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Introduction

Just 200 years ago, in October 1781, Carl Linnaeus fil. published the name *Banksia* together with the first four species in the genus. Joseph Banks had already been honoured in the genus *Banksia* Forster & Forster f. (1775) and was also recognised later in *Banksea* Koenig (1783), *Bankesia* Bruce (1790) and *Banksia* Dombey ex DC. (1828). By 1800, however, the name was generally accepted for the genus in the Proteaceae and has since been challenged only by Kuntze (1891) and Britten (1905). It was formally conserved against *Banksia* Forster & Forster f. in 1940 by Sprague.

The historical progress of the publication of new species in the genus is given in Table 1. This includes only the taxa here accepted as valid. From the late 18th Century to the mid 19th, many other names were applied both to collections gathered in the wild and to specimens raised in European glasshouses. Some of these can be assigned in synonymy to accepted names, but others were inadequately described and remain doubtful. A list of *nomina dubia* published in *Banksia* L.f. (Proteaceae) is given on p.461, while names published in *Banksia* in other families are given on p.462.

Table 1

Accepted taxa in *Banksia* L.f. in chronological order of publication. New combinations and new names based on earlier taxa are included under the date of the earlier publication. The number in brackets is that of the species in the text.

1781 *B. serrata* L.f. (15)
B. integrifolia L.f. (2)
B. ericifolia L.f. (50)
B. dentata L.f. (1)

1793 *B. spinulosa* Smith (49)

1798 *B. grandis* Willd. (40)

1800 *B. repens* Labill. (42)

1800 *B. oblongifolia* Cav. (7)
B. robur Cav. (8)
B. marginata Cav. (4)

1802 *B. praemorsa* Andrews (28)

1810 *B. pulchella* R.Br. (68)
B. sphaerocarpa R.Br. (57)
B. nutans R.Br. (69)
B. collina R.Br. = *B. spinulosa* Smith var. *collina* (R.Br.) A. S. George (1981) (49)
B. occidentalis R.Br. (52)
B. littoralis R.Br. (53)
B. compar R.Br. = *B. integrifolia* L.f. var. *compar* (R.Br.) Bailey (1913) (2)
B. verticillata R.Br. (54)
B. coccinea R.Br. (48)
B. paludosa R.Br. (9)
B. attenuata R.Br. (30)
B. aemula R.Br. (16)
B. quercifolia R.Br. (12)
B. speciosa R.Br. (19)
B. ilicifolia R.Br. (70)

1827 *B. cunninghamii* Sieber ex Reichb. = *B. spinulosa* Smith var. *cunninghamii* (Seiber ex Reichb.) A. S. George (1981) (49)

1828 *B. dryandroides* Baxter ex Sweet (56)

1830 *B. media* R.Br. (27)
B. caleyi R.Br. (46)
B. baueri R.Br. (14)
B. menziesii R.Br. (18)
B. solandri R.Br. (11)
B. baxteri R.Br. (20)
B. goodii R.Br. (39)
B. prostrata R.Br. non Forster & Forster f. (1776) = *B. gardneri* A. S. George (1981) (40)
B. brownii Baxter ex R.Br. (51)

1840 *B. prionotes* Lindley. (23)

1845 *B. meisneri* Lehm. (67)

Table 1—*continued*

1853 *B. ornata* F. Muell. ex Meissner (17)

1855 *B. pinifolia* Meissner non Salisb. (1796) = *B. leptophylla* A. S. George (1981) (60)
B. tricuspis Meissner (55)
B. candolleana Meissner (21)
B. elegans Meissner (38)
B. victoriae Meissner (24)
B. hookerana Meissner (25)
B. lindleyana Meissner (31)
B. sceptrum Meissner (22)

1856 *B. laevigata* Meissner (35)
B. lemanniana Meissner (45)

1857 *B. sphaerocarpa* R.Br. var. *glabrescens* Meissner = *B. incana* A. S. George (1981) (65)

1864 *B. blechnifolia* F. Muell. (43)
B. petiolaris F. Muell. (44)

1869 *B. quercifolia* R.Br. var. *integrifolia* F. Muell. = *B. oreophila* A. S. George (1981) (13)

1896 *B. elderana* F. Muell. & Tate

1928 *B. violacea* C. Gardner (66)
B. audax C. Gardner (34)

1934 *B. ashbyi* E. G. Baker (32)
B. burdettii E. G. Baker (26)

1964 *B. laricina* C. Gardner (64)
B. pilostylis C. Gardner (29)
B. benthamiana C. Gardner (33)

1966 *B. laevigata* Meissner subsp. *fuscolutea* A. S. George (35)

1966 *B. lullfitzii* C. Gardner (36)

1967 *B. canei* J. H. Willis (5)

1981 *B. conferta* A. S. George var. *conferta* (3)
B. conferta A. S. George var. *penicillata* A. S. George (3)
B. saxicola A. S. George (6)
B. gardneri A. S. George var. *brevidentata* A. S. George (40)
B. gardneri A. S. George var. *hiemalis* A. S. George (40)
B. chamaephyton A. S. George (41)
B. aculeata A. S. George (47)
B. ericifolia L.f. var. *macrantha* A. S. George (50)
B. integrifolia L.f. var. *aquilonia* A. S. George (2)
B. littoralis R.Br. var. *seminuda* A. S. George (53)
B. sphaerocarpa R.Br. var. *caesia* A. S. George (57)
B. sphaerocarpa R.Br. var. *dolichostyla* A. S. George (57)
B. micrantha A. S. George (58)
B. grossa A. S. George (59)
B. lanata A. S. George (61)
B. scabrella A. S. George (62)
B. telmatiaea A. S. George (63)
B. meisneri Lehm. var. *ascendens* A. S. George (67)
B. nutans R.Br. var. *cernuella* A. S. George (69)
B. cuneata A. S. George (71)
B. plagiocarpa A. S. George (Addendum)

When Linnaeus fil. published *Banksia*, he assigned it to the *Tetrandria*, *Monogynia* but gave no other description of the floral structure except to describe the perianth of *B. serrata* as "very spreading, ascending; laminae pubescent outside, greyish-white" (my translation). He described the inflorescence ("amentum") as "very large, thick, terete, obtuse, erect." His four species were distinguished chiefly on foliar characteristics.

The first attempt to describe details of the morphology of the *Banksia* flower and fruit was made by Joseph Gaertner (1788), who recognised the essentially tubular nature of the perianth and correctly interpreted the false dissepiment which lies between the seeds in the follicle. He was mistaken, however, in considering the ovary to be bilocular. Besides species of *Banksia* sensu stricto, he included under *Banksia* three species which were later transferred to other genera, and puzzlingly referred in his generic description to a "quadrifid calyx". Gaertner figured the auricles of the cotyledons of *Banksia serrata* (which he re-named *conchifera*) but made no mention of them in his description.

Some confusion over the generic limits of *Banksia* continued in the 1790s, as seen in the work of James Smith (1793) and Carl Willdenow (1798), but the situation was reviewed by Antonio Cavanilles (1800A). Cavanilles provided detailed descriptions of 11 species of *Banksia* from the Sydney region, of which 4 were later relegated to synonymy. He added many new observations but still regarded the ovary as bilocular. The whole style-end was still referred to as the stigma. Cavanilles was the first to remark upon the habit in *Banksia* (and later noted by others in many Proteaceae) of prolific flower production for very few fruit. His paper was repeated but entirely in Latin and with additional figures (Cavanilles 1800B).

A major advance in understanding not only *Banksia* but the whole of the Protcaceae was made by Robert Brown in his paper on the family (1810A). Brown had the advantage of having studied many Australian and a few South African species in the field. He discussed the relative importance of such characters as the leaves, indumentum, inflorescence, perianth, anthers, hypogynous glands or scales, anthers, style, fruit and seeds. He also discussed the geographical distribution, this being a subject that had begun to interest him during the expedition to Australia. The basic morphology of the family was now clarified, though the nature of the style-end was still not understood. Brown's generic classification for the Protcaceae proved to be very sound (Johnson & Briggs, 1975). His treatment of *Banksia* in both 1810 and 1830 has also endured except for a few instances where he apparently placed too much emphasis on foliar characters to separate species, e.g. in the *marginata* complex. He also incorrectly placed *B. verticillata* next to *B. compar* (= *B. integrifolia* var. *compar*).

Following Robert Brown, three 19th Century botanists made significant contributions to the taxonomy of *Banksia*. In the 1850s Carl Frederick Meissner described ten new species from Western Australia based on the collections of James Drummond. He also, in 1856, proposed the first infrageneric classification of the genus beyond the earlier segregation into the sections *Isostylis* R.Br. and *Eubanksia* Endl. (*Banksiae verae* of Brown). In the latter section, Meissner proposed three series, *Abietinae*, *Salicinae* and *Quercinae*. The first of these contained only hooked-style species but the two others were quite heterogeneous. His specific treatment, however, was in general an excellent survey of all the species described to that date. Soon afterwards, Bentham (1870) also treated the whole genus. He revised earlier subdivisions and divided the genus into five sections, of which only *Isostylis* corresponded with that of earlier writers. He restricted *Eubanksia* to 3 species, discarded Meissner's three series and instead proposed three new sections, *Oncostylis*, *Cyrtostylis* and *Orthostylis*. Like Meissner he grouped the hooked-style species together (in *Oncostylis*) but correctly went further to include all such species then known. His two other new sections, however, were heterogeneous.

Bentham recognised that the stigmatic area of the style-end was very small and that the chief function of the remainder was to collect pollen from the anthers just before anthesis. He elaborated his studies of the Proteaceous style in an illustrated paper to the Linnean Society of London (Bentham, 1871).

During the latter half of the 19th Century, Ferdinand Mueller added much to the knowledge of distribution of *Banksia*, though the information was scattered through many publications. He also described three new species, the last in conjunction with Ralph Tate.

In the 20th Century a further nine species were described before the start of this revision, six from Western Australia by Charles Gardner. Most of these were recent discoveries in regions previously difficult of access, though some had been collected earlier and not recognised as distinct. There was no attempt, however, to revise the infrageneric classification of the genus. This has been done in the present study, resulting in its division into two subgenera, one with two species, the other with two sections and twelve series. Further, ten new species and nine new varieties are described, two previously named varieties are re-described as species, and new names are provided for two species whose names where later homonyms. Two new varietal combinations are made in the previously confused *spinulosa* complex.

Methods

While essentially an exercise in classical taxonomy, the paper is based on the study of the available literature and herbarium material, on an examination of all taxa in the field, and on a study of plants raised from seed in the shadehouse and garden. Field studies have been especially useful: had the revision been based only on the literature and herbarium material, much less information would have been available and many of the conclusions would have been tentative. Even so, there are taxa where further research is needed in order to understand the variation. This is especially so in the eastern species *B. integrifolia* L.f., *B. marginata* Cav. and *B. spinulosa* Smith. There are also many aspects such as phenology, floral and fruit development, pollination, seed production, and predation which should be studied, so leading to a fuller understanding of a complex and fascinating group of plants.

Herbarium material has been seen from all herbaria where relevant collections are known to be lodged, these being listed in the Acknowledgments. The specimens were studied in some instances while visiting the herbaria, in others while on loan. Types were traced of all names except some based on early European cultivated plants. Apart from types, few collections, besides modern ones in Australian herbaria, were of much use in describing the full morphology, variation, distribution and habitat. Even in modern collections the complement of leaves, flowers, fruit, and data on habit and habitat is rarely achieved.

For many taxa it has been necessary to select lectotypes, usually from a series of isotypes but in some cases from syntypes. For several taxa when no type was cited or when the type material is apparently missing, neotypes have been nominated.

All taxa have been seen in the field, though for some this has not covered all the known variation. Collections were made showing bark, new growth, floral development, fruit, seeds and, when present, seedlings. Data were gathered on habit and habitat. In particular the nature of the stems and rootstocks was noted, for this information is relevant to fire response and is generally consistent for each taxon. Most taxa have been seen in recent post-fire situations.

Full descriptions are given for all species, including, where available, that of the cotyledons and seedling leaves. While this makes the descriptions very long, I think that it is worth including so that a full picture of the morphology is available. Data on seeds and seedlings may be useful for the identification of species at such stages when there is no accompanying herbarium material of the mature plant. In general, the seedlings have been described from living material and the remainder of the plant from dried material.

Distribution is given both in maps and in brief descriptions. Selected collections only are cited, these mostly being good specimens chosen to show the distribution. Habitat and flowering period are also stated briefly. Vegetation formations generally follow the nomenclature of Specht *et al.* (1974).

In the discussion under each species I have outlined the diagnostic characters, variation and interspecific relationships. The last are based on morphological grounds as well as assessment of the species in the field.

With experience, most species of *Banksia* can be determined from any one of the major parts—leaves, inflorescence, flowers, infructescence or follicles. There is, however, a wide range in the "distinctiveness" of species, from those easily recognised by any feature —e.g. *B. coccinea*, *B. dryandroides*, *B. candolleana*—to those in which a combination of features may be needed for positive determination. The latter applies mainly in the series *Abietinae*, *Crocinae* and *Prostratae*. My basic principle regarding specific limits has been to require a significant and consistent difference in the morphology of the flowers and/or fruit. Generally such differences are accompanied by others in habit, leaves, seeds, flowering time, etc. In two cases, however, where taxa are distinct in habit and to some extent in leaf morphology, I have retained them as varieties because they cannot be separated on the basis of their flowers and fruit. These are *B. spinulosa* and *B. littoralis*.

The citation of authors of plant names follows the Draft Index of Author Abbreviations compiled at The Herbarium, Royal Botanic Gardens, Kew (1980).

All photographs were taken by the author.

Morphology

Habit. All species are trees or woody shrubs, usually erect. Arborescent forms, which have been recorded up to 25 m tall, develop a trunk up to 70 cm diameter. One series, the *Prostratae*, contains 6 species in which the branches are prostrate on or below the soil with erect leaves and inflorescences. Two species of the series *Abietinae* have lateral branches tending towards the prostrate habit. In *B. scabrella* the lowest of the lateral branches rest on the ground and often produce inflorescences. *Banksia micrantha* has developed a stage further, its laterals often at first growing underground for up to 60 cm before emerging to continue as ascending aerial stems. The underground stems bear many subulate prophylls.

In all growth forms there are both fire-tolerant and fire-sensitive forms, a characteristic consistent within each taxon except *B. marginata* and *B. violacea* (Table 2, column 1). Fire-tolerant forms have either a lignotuber or a trunk protected by thick bark, and sprout by epicormic shoots after fire. Fire-sensitive forms either lack a lignotuber or have thin bark (less than 5 mm thick); they are killed by fire and regenerate from seed.

Bark. Bark characters are usually consistent within a taxon and can aid determination. Fire-tolerant arborescent species have bark 1–3 cm thick. Fire-sensitive arborescent species and the narrow stems of lignotuberous species have bark less than 5 mm thick which is unable to protect the stems against fire. Lenticels are often present in young bark and in some species it is their continued development as corky outgrowths that leads to mature fissured bark. In others the bark splits as it grows and expands.

Indumentum. An indumentum occurs in most species on branchlets, leaves, all bracts of the inflorescence, perianth and follicles. Sometimes it is absent from one or more of these organs, but no species is quite glabrous. Although some species are variable in this feature it is usually helpful in distinguishing taxa. For the leaves and branchlets, young new growth is essential if the total indumentum is to be observed, for the hairs usually begin to come away during growth and may be almost or quite gone by the time leaves are mature. This applies especially to the upper surface and the veins of the lower surface. The fine white wool which fills the lacunae on the lower surface is persistent.

The hairs are 3-cellular and uniseriate (Johnson and Briggs, 1975), though the two lower cells are usually very short so that only the long apical one is readily seen. They take two main forms—long and straight or flexuose (described as hirsute or villous), and short and curled (described as pubescent or tomentose). Intermediate forms also occur. Often long and short hairs occur together, the organ then being described as hirsute and tomentose. The long hairs usually wear off first, but sometimes persist, e.g. on the branchlets of *B. spinulosa* var. *cunninghamii*.

Species which differ from the usual state of the indumentum in certain organs are as follows:

1. new growth glabrous or almost so in *B. micrantha*. *B. nutans*, *B. oreophila*, *B. pulchella* and *B. quercifolia;*
2. perianth glabrous in *B. aculeata*, *B. attenuata*, *B. caleyi*, *B. lemanniana* and *B. lindleyana;*
3. styles pubescent or papillose in most of the series *Orthostylis* and in *B. pilostylis;*
4. follicles from the beginning glabrous or almost so in *B. nutans* and *B. tricuspis*.

There are two basic types of branching. In many species a whorl of branchlets arises immediately below the apex of a main branch, whether or not the terminal bud of the latter produces an inflorescence or an extension of the main branch. The other method is seen in some species in which the inflorescences are produced on short lateral branchlets. These develop short branchlets in many leaf axils which may or may not later develop into either vegetative shoots or inflorescences.

Branchlets. The branchlets usually bear scattered prophylls along the basal few centimetres. Some of these form the protective involucre about the branchlet initial and are carried up the branchlet as it elongates. Usually they are very early deciduous, leaving the lower part of the branchlet bare. Sometimes the prophylls are absent, especially on lateral branchlets.

Leaves. The leaves show a great range of form, texture and colour, as well as usually being different in the juvenile and adult stages. Most species can be recognised by their adult leaves alone but this is difficult in several groups of closely related species. The typical *Banksia* leaf is flat with entire or dentate flat or slightly recurved margins. Derived states are the deeply lobed to pinnatisect leaves, and the linear leaves with entire revolute margins. The latter are characteristic of the series *Abietinae*, while those of the *Spicigerae* are intermediate in form.

In adult branches the leaves may be arranged in spirals (though often irregular), or in whorls, or they may be crowded. The last occurs in some species of the series *Spicigerae* and *Abietinae*.

Seedling leaves are discussed below.

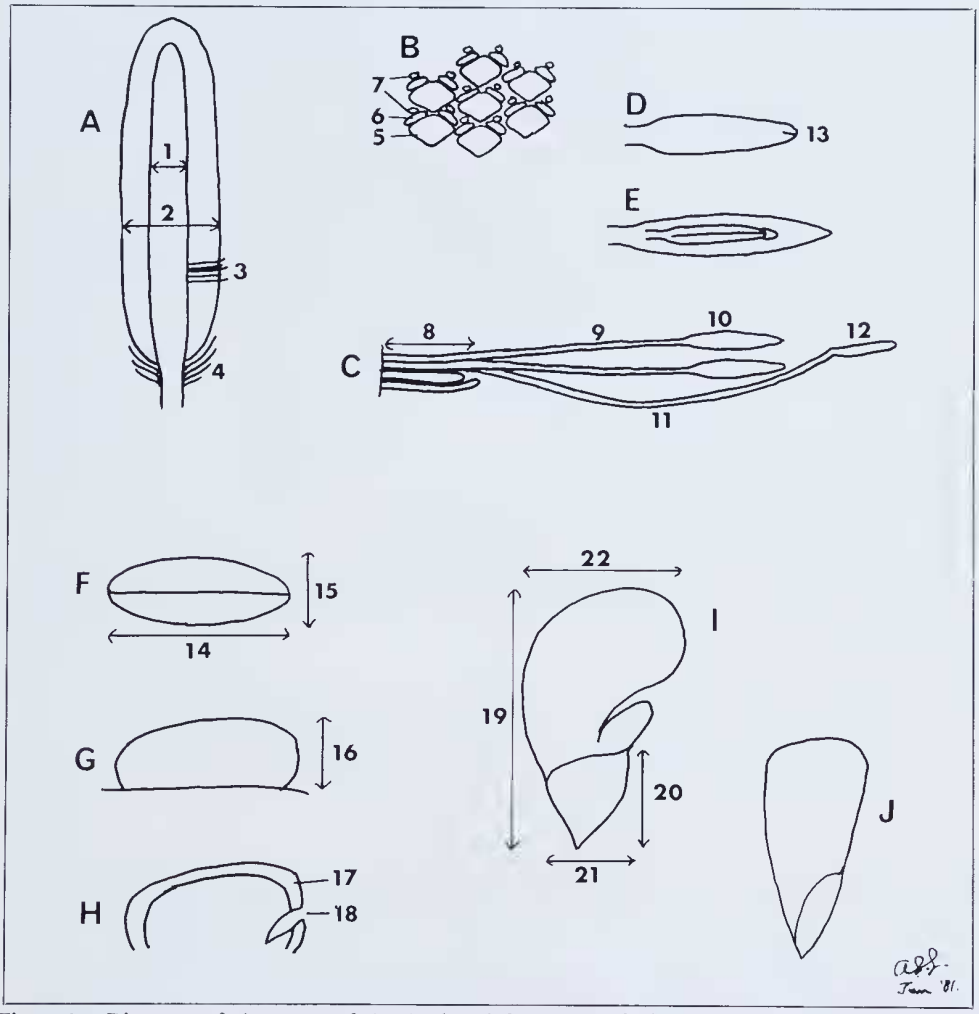


Figure 1. Diagrams of characters of the *Banksia* inflorescence, follicle and seed. A. Axis: 1—width, 2—width with common bracts, 3—common and floral bracts, 4—involucral bracts. B. Surface view of common and floral bract arrangement in subtending flowers: 5—common bract, 6—floral bract, 7—flower base. C. Two perianth laminae and pistil; 8—base of perianth enclosed by bracts, 9—perianth claws, 10—perianth limb, 11—style, 12—pollen-presenter. D. Pollen-presenter showing terminal stigmatic groove, 13. E. Perianth limb inside showing anther on short filament, with apiculum. F. Follicle in plan view: 14—length, 15—width. G. Exserted part of follicle in side view: 16—height. H. Inner face of upper part of follicle: 17—lip, 18—split at stylar point. I. Seed with lateral lobe to wing: 19—overall length, 20—length of seed body, 21—width of seed body, 22—width of wing. J. Seed without lateral lobe.

Inflorescence. (Figure 1A–E). The *Banksia* inflorescence is a complex structure whose form and development need further study. It consists of a central woody axis on which are borne tightly-packed unit inflorescences at right angles to the axis. The unit inflorescence contains two sessile flowers, each subtended by a floral bract. Each pair of floral bracts is subtended by a third bract here referred to as a *common bract* (Johnson & Briggs, 1975, p.115). The common bract is larger than the floral bracts and may be diagnostic, e.g. in *B. conferta*, *B. nutans*, *B. laevigata* and *B. scabrella*. The last two species are unusual in having awned common bracts, the usual state being truncate to shortly conical. The axis itself is hirsute and the common and floral bracts are also densely hirsute. The hairs are various shades of ferruginous brown except in *B. lanata*, in which they are white; they are straight until the bracts are dissected out, whereupon they curl markedly. The unit inflorescences are so arranged on the axis that there are three pattern lines—vertical, and both dextral and sinistral spiral (Fig. 49A). In some species such as *B. prionotes* the whole pattern persists until anthesis, or one spiral may predominate, e.g. *B. speciosa*. In others the vertical pattern becomes dominant, e.g. *B. menziesii*, *B. ericifolia* and *B. coccinea*, while in others again all pattern disappears, e.g. *B. integrifolia* and *B. sphaerocarpa*. Throughout this paper I have used the term *inflorescence* for the whole structure in preference to *conflorescence* (Johnson & Briggs, 1975) and *synflorescence*.

The axis produces flowers for most of its length but usually there is an area at the base where common and floral bracts occur without flowers and often a similar area at the apex. At the base of the axis there are different bracts usually occupying about 1 cm of the branchlet but sometimes extending farther down. These bracts, here termed the *involucral bracts*, are typically narrowly linear on thickened bases. They may be deciduous early or persist until anthesis or fruit formation.

Development of the inflorescence is typically acropetal, but in two species of the series *Quercinae* (*B. oreophila* and *B. quercifolia*) and in the whole section *Oncostylis* (except *B. nutans*) it is basipetal. Basipetal development in *Banksia* was first described in detail by Blake (1971), who also discussed other morphological details of the development of flowers and fruit. The anomalous situation of *B. nutans* among the other *Oncostylis* is notable: since the inflorescence is pendulous, the effective sequence of floral development and opening is the same as in the other species.

In most species the development of the inflorescence—from emergence of the axis to anthesis—takes 2–4 months. In several it takes longer, most noticeably in *B. baueri* (5–6 months) and *B. sceptrum* (6–7 months). Anthesis along the whole axis of an inflorescence varies in time from a few days, e.g. *B. littoralis*, *B. caleyi*, to 2–3 weeks, e.g. *B. prionotes*, *B. menziesii*.

The inflorescence may be terminal to a main branch, in which position it may or may not have a whorl of lateral branchlets immediately below, or it may be terminal to a small branchlet lateral from older stems. In the latter case inflorescences may occasionally also be terminal to the main branch, e.g. in *B. grossa*, *B. baueri*.

Flowering periods are listed in Table 2, column 3.

Flower colour. (Table 2, columns 4 and 5). The basic flower colour in *Banksia* is yellow which occurs in various shades from cream to golden brown in 42 species. Other colours are orange or orange-brown (11 species), red, purplish-brown and mauve-pink. In the section *Oncostylis* the dominant flower colour is often provided by the style. This is also the case in *B. coccinea* in which the brilliant red comes entirely from the styles, the perianths being greyish. In the series *Crocinae* a woolly indumentum masks much of the perianth so that the latter provides some colour only when the inner surface is partially visible at anthesis; the orange colour here again comes mostly from the styles. Most species are consistent in flower colour but some show variation, e.g. *B. baueri* (fawn or ferruginous); *B. ericifolia* (styles orange or red); *B. littoralis* var. *seminuda* (styles yellow or red); *B. menziesii* (flowers deep red, pink, chocolate or pale yellow); and *B. spinulosa* (styles yellow, red or purple-black). Individual pale-flowered plants occur in some species, e.g. *B. coccinea*, *B. praemorsa* and *B. ericifolia*. The flowers usually turn brown after anthesis but in some species they simply fade.

Table 2

Summary of some biological data of *Banksia* species. Number in brackets is the species' number in the text.

Column 1. Response to fire—K: killed by fire, regenerates from seed; E: regenerates by epicormic shoots from trunk; L: regenerates by epicormic shoots from lignotuber.

Column 2. Follicle dehiscence—S: open spontaneously when mature; F: remain closed until burnt; U: some open spontaneously, some require fire.

Column 3. Flowering period—A: summer; T: autumn; H: winter; V: spring.

Column 4. Dominant perianth colour at anthesis—Y: yellow; C: cream; O: orange; R: red; B: brown; M: mauve to purplish brown; G: grey-white

Column 5. Dominant style colour at anthesis—Y: yellow; C: cream; O: orange; R: red; N: dark purple.

Column 6. P: Perianths and styles persistent on infructescence; D: perianths and styles soon deciduous

Species	1	2	3	4	5	6
aculeata (47)	K	F	A	Y	Y	P
aemula (16)	E, L	U	T	Y	Y	P
ashbyi (32)	K	F	H	O	O	P
attenuata (30)	E, L	U	V–A	Y	Y	P
audax (34)	L	F	A	O	O	P
baueri (14)	K	F	H	M, B	C	P
baxteri (20)	K	F	A–T	Y	Y	P
benthamiana (33)	K	F	A	O	O	P
blechnifolia (43)	K	F	V	E	Y	P
brownii (51)	K	F	H	B	R	P
burdettii (26)	K	F	A	O	O	P
caleyi (46)	K	F	V–A	R	Y	P
candolleana (21)	L	F	T–H	Y	Y	P
canei (5)	?L	U	T–H	Y	Y	D
chamaephyton (41)	L	F	V	B	C	P
coccinea (48)	K	F	H–V	G	R	D
conferta var,. *conferta* (3A)	?E	F	T	Y	Y	P
var. *penicillata* (3B)	K	F	T	Y	Y	P
cuneata (71)	?K	F	V–A	C, R	C	D
dentata (1)	E	S	A–T	Y	Y	D
dryandroides (56)	K	F	V	B	Y	P
elderana (37)	L	F	T	Y	Y	P
elegans (38)	E, L	F	V	Y	Y	D
ericifolia var. *ericifolia* (50A)	K	F	T–H	Y	O, R	P
var. *macrantha* (50B)	K	F	T–H	Y	O, R	P
gardneri var. *gardneri* (40A)	L	F	V	B	C	P
var. *brevidentata* (40B)	L	F	H	B	C	P
var. *hiemalis* (40C)	L	F	H	B	C	P
goodii (39)	L	F	V	B	Y	P
grandis (10)	E	S	V–A	Y	Y	D
grossa (59)	L	F	T–H	B	Y	P
hookeriana (25)	K	F	H	O	O	P
ilicifolia (70)	E	U	H–V	Y	Y	D
incana (65)	L	F	A	Y	Y	D
integrifolia var. *integrifolia* (2A)	E	S	A–H	Y	Y	D
var. *compar* (2B)	E	S	A–H	Y	Y	D
var. *aquilonia* (2C)	E	S	A–H	Y	Y	D
laevigata subsp. *laevigata* (35A)	K	F	V	Y	Y	P
subsp. *fuscolutea* (35B)	K	F	A	Y	Y	P
lanata (61)	K	F	V	C	N, C	P
laricina (64)	K	F	H	Y	Y	D
lemanniana (45)	K	F	V–A	Y	Y	P
leptophylla (60)	K	F	A–H	Y	Y	P
lindleyana (31)	L	F	A–T	Y	Y	P
littoralis var. *littoralis* (53A)	E	S	T–H	Y	Y	D
var. *seminuda* (53B)	K	S	T–H	Y	Y(R)	D
lullfitzii (36)	L	F	T	B	Y	P
marginata (4)	K, L	S(F)	T–H	Y	Y	P, D
media (27)	K	F	T–H	Y	Y	P

Table 2—*continued*

Species	1	2	3	4	5	6
ueisueri var. *ueisueri* (67A)	K	F	T–H	Y	Y	P
var. *asceudens* (67B)	K	F	T–H	Y	Y	P
meuziesii (18)	E, L	S	A–H	R	R	D
micrantha (58)	L	F	T	Y	Y	P
nutans var. *nutans* (69A)	K	F	V–A	M	C	P
var. *cernuella* (69B)	K	F	A	M	C	P
oblongifolia (7)	L	U	T	Y	Y	D
occidentalis (5)	K	F	A	Y	R	P
oreophila (13)	K	F	H	M	C	P
ornata (17)	K	F	T–H	Y	Y	P
paludosa (9)	L	F	T–H	Y	Y	P
petiolaris (44)	K	F	V	Y	Y	P
pilostylis (29)	K	F	V	Y	Y	P
praemorsa (28)	K	F	H–V	R, Y	Y	P
prionotes (23)	K	U	A–H	O	O	D
pulchella (68)	K	F	T–H	Y	Y	D
quercifolia (12)	K	F	H	B	Y	P
repens (42)	L	F	V	C	C	P
robur (8)	L	F	A–H	Y	Y	P
saxicola (6)	K	U	A	Y	Y	D
scabrella (62)	K	F	V	C	C, N	P
sceptrum (22)	K	F	A	Y	Y	P
serrata (15)	E	U	A–T	Y	Y	P
solaudri (11)	K	F	V	M	Y	P
speciosa (19)	K	F	A–T	Y	Y	P
sphaerocarpa var. *sphaerocarpa* (57A)	L	F	A–T	B	Y	P
var. *caesia* (57B)	L	F	A–T	Y	Y	P
var. *dolichostyla* (57C)	L	F	T	Y	Y	P
spinulosa var. *spinulosa* (49A)	L	F	T–H	Y	Y, R	P
var. *collina* (49B)	L	F	T–H	Y	Y, R	P
var. *cunninghamii* (49C)	K	U	T–H	Y	N	P
telmatiaea (63)	K	F	H	B	Y	P
tricuspis (55)	E	F	T–H	Y	Y	D
verticillata (54)	?K	U	A	Y	Y	D
victoriae (24)	K	F	A	O	O	P
violacea (66)	K, L	F	A	N	N	P

Perianth. (Figure 1C) The perianth is actinomorphic or slightly zygomorphic, the latter appearing in the upper part and the limb which may be turned upwards or downwards before anthesis. The perianth remains tubular at the base where enclosed within the common and floral bracts and is always glabrous here. In the following descriptions the indumentum of the outside of the perianth refers to the part distal to this. Before or at anthesis the exserted part of the perianth splits into four segments here termed the *claws* which end in an anther-bearing portion termed the *limb*, both terms being of long-standing use in the Proteaceae. The claws are narrowly linear to filiform and usually taper upwards. The form and presence or absence of the indumentum on the claws is consistent in most species. Likewise the size, form and indumentum of the limb is consistent. An unusual development is seen in the series *Quercinae* in which the limb is produced into a filiform terminal awn.

Anthers. All four anthers are perfect. They are on short filaments and the connective is produced into a short apiculum. The pollen is deposited on the pollen-presenter just before anthesis.

Hypogynous scales. Four sessile scales alternate with the perianth segments. They are narrow, thin and translucent, usually less than 2mm long. The longest are those of *B. sceptrum*, some 4–5 mm long. The scales are often difficult to distinguish, especially in those species in which they adhere to the perianth.

Pistil. The pistil is usually stiff and wiry though it is very slender in several species, especially *B. marginata* and *B. laevigata*. It may be quite straight or gently bowed, with the apex straight, markedly hooked or, in a few species, slightly kinked (*B. baueri*) and in one sigmoid (*B. sceptrum*). In all species except those of the series *Tetragonae*, the style is exserted through a split formed by the separation of the lower pair of perianth segments, becoming bowed as it elongates but being still held at the apex by the perianth limb. Anthesis occurs when the limb opens; the released style then usually protrudes beyond the perianth which often relaxes. In the *Quercinae* and the *Tetragonae*, however, the limb simply separates and loosely surrounds the pollen-presenter.

The term *pollen-presenter* (Figure 1D), as discussed by Rourke (1969), George (1974) and Johnson and Briggs (1975), is used here for the modified style-end in *Banksia*. The stigmatic area is a very small groove at or oblique to the apex of this structure, or apparently, in *B. oreophila* and *B. quercifolia*, a lateral area. The main function of the modified style-end is to act as a repository for pollen shed by the anthers just before anthesis, after which it "presents" it for the pollinator. The pollen-presenter may be entirely covered with pollen or the extreme apex may be left bare. It does not, as suggested by Nelson (1978), also act as a pollen collector for pollination. Pollination is effected by pollen being pressed into the stigmatic groove.

The ovary is sessile and 1-locular with two ovules laterally attached. It may be glabrous or pubescent to hirsute about the apex, often with the hairs longer on one side.

Infructescence. The *Banksia* infructescence is a massive, woody structure. The axis becomes thicker, and the common and floral bracts persist, usually becoming indurated and often enlarging slightly. The involucral bracts may persist but usually they are deciduous, if not by anthesis then by the time the fruit is mature. Only a small proportion of flowers sets fruit, and often an inflorescence produces none at all. Some species characteristically set very few follicles per infructescence.

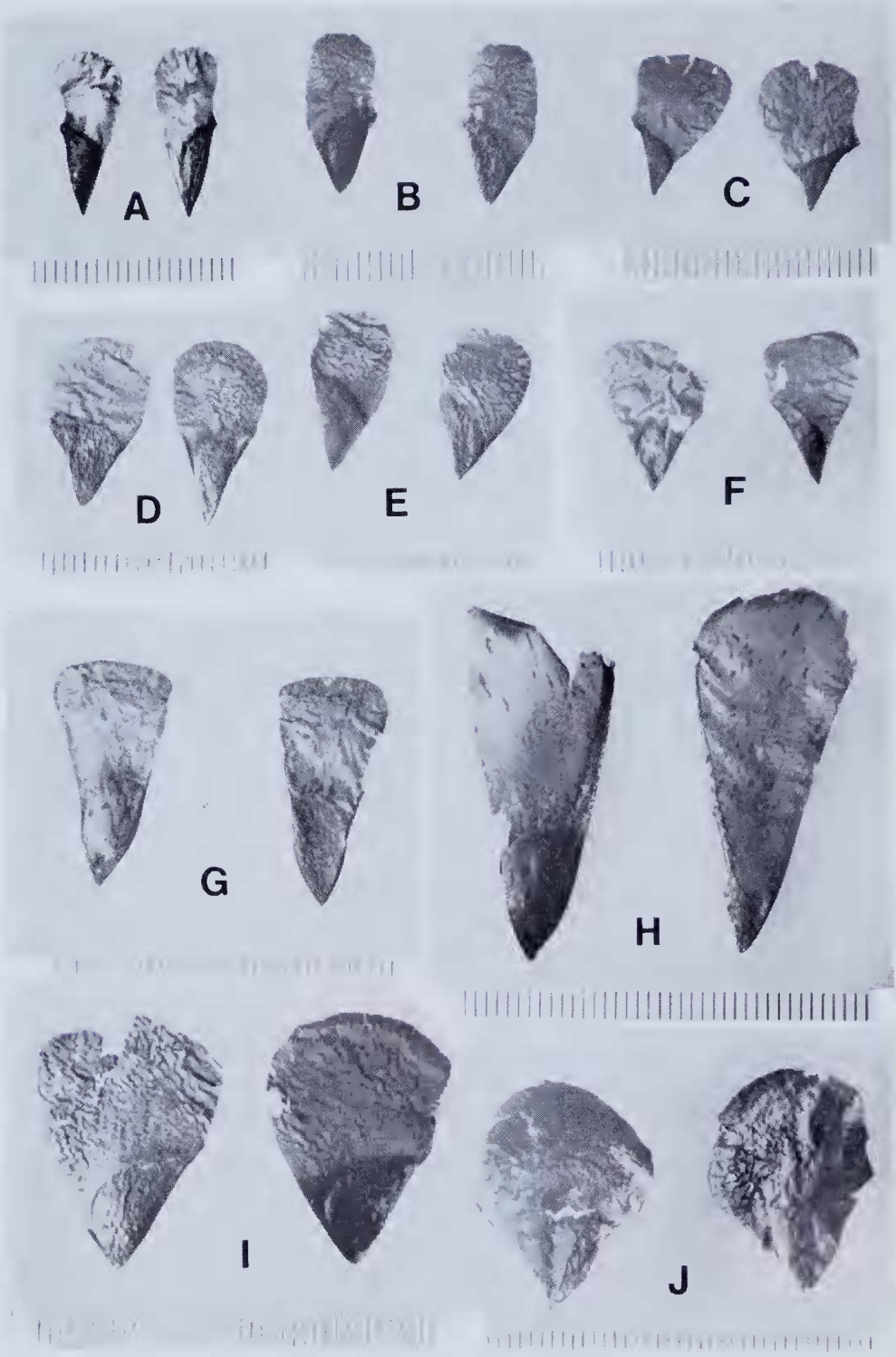
The fruit is a woody follicle which is variously enlarged, sometimes sculptured, and usually has an indumentum at least when young. There is often a wide range in the number and size of the follicles in each species but in general the form and size are characteristic. Only a few closely related taxa cannot always be separated on the basis of follicles alone.

In the descriptions the follicle is described in terms of the portion which is visible without dissecting the infructescence (Figure 1F–H). The following attributes are listed: shape in plan view, i.e. as seen from directly above the follicle; length along the axis of the suture; height of the apex above the common and floral bracts; width across the widest part, at 90° to the suture; shape of the valves in side view, their curvature, surface, indumentum and any relevant markings; the form of the apical ridge; and the suture.

For most species a diagnostic character of the infructescence is the retention or shedding of the old perianths and styles (Table 2, column 6). In 18 species they are completely deciduous before the seeds are mature, while in the others they persist at least for several years. A slightly different development is seen in *B. spinulosa*, especially var. *cunninghamii*, where the styles fall during the first year or so but the perianths persist. Occasionally some plants of species which normally shed the perianths may retain them, e.g. *B. menziesii* (J. Scott, pers. comm.). The character is especially useful in distinguishing the infructescences of some species in the series *Abietinae*.

Fully developed follicles may contain two, one or no viable seeds. There is a high rate of predation in many species (e.g. Scott, 1980). The seed consists of a basal seed body and a terminal wing. Important features of the seed body are its shape, size, the presence or absence of a ridge across the upper inner margin and the texture or sculpturing of the inner and outer surfaces. The size and form of the wing are also important. The wing is simple in those species in which the valves of the follicle do not split on opening, but in all others it is notched along the line of the split, leaving a small lateral lobe. A selection of seeds is shown in Figures 2 to 7.

In the descriptions, the overall length of the seed is given first, followed by the form, size and details of the seed body, then the form and greatest width of the wing (Fig. 1I and J).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The seeds are separated in the follicle by a two-winged plate which is a false dissepiment formed from the outer integuments (Johnson and Briggs, 1975). For this plate I have used the term *separator*. It has limited use as a specific character, though it is diagnostic for some series. Usually it is crustaceous, sometimes, especially in the series *Orthostylis* and *Tetragonae*, even woody, but in a few species it is rather thin, e.g. *B. sphaerocarpa*. Above the impressed base against which the seed body lies, there is usually a transverse thickening which may be enlarged into an overhanging ridge. This assists in holding the seed in the follicle when it first opens.

In 7 species the follicles open spontaneously to release their seed when mature (Table 2, column 2). In several others some open thus and others remain closed until burnt. In all other species they normally remain closed until burnt (air-drying alone being insufficient), but a few will sometimes open spontaneously. The degree of opening is sometimes diagnostic for a species, e.g. in *B. nutans* and *B. incana* where they open very narrowly.

In the series *Salicinae* and *Grandes*, in the section *Oncostylis* and in two species of the series *Quercinae* the valves split simply along the suture. In all other species each valve develops a split which begins at the stylar point and curves downwards, resulting in the formation of a lateral beak. I consider the former state the more primitive and the latter a derivative from it.

The seed in most species is readily released after the follicles open, but in some species, especially in the series *Abietinae*, it remains tightly held in the follicle and is released only after subsequent wetting. The separator is hygroscopic, and when moistened its wings close together, recurving as they dry out again. When the follicles first open the wings hold the seeds in place, but subsequent wetting and drying loosens them. The wings may act rather like levers as they dry, drawing the seeds upwards in the follicles. The seeds spin as they fall.

Seedlings. Seedlings have been raised of 58 species of *Banksia*, as well as of 3 infraspecific taxa. In most cases specimens have been planted out in a special bed at PERTH where their continuing growth has been observed. Seed was gathered from the wild in most cases and vouchers exist as either herbarium specimens or carpological collections. A further 6 species were received as seedlings from nurseries, including Kings Park. Table 4 lists those taxa in which seed is released when mature and those which retain their seed. The latter usually require heat treatment before the follicles open, this in the wild usually being by means of a bushfire. Occasionally a few follicles are seen open on unburnt plants, but I do not know if the seeds so released are viable. Artificial opening of follicles was achieved by dowsing the infructescence with methylated spirits and setting it alight. The follicles usually opened within a few minutes, the initial splitting along the suture sometimes being accompanied by a faint click. In many species the follicles opened widely enough for the seed to be easily extracted, but in others several burns were needed with subsequent wetting and drying, and sometimes physical splitting open of the follicle.

In most cases seed germinated within 3–8 weeks when placed in a shadehouse in sand, lightly covered and kept moist. The subalpine taxa—*B. canei*, *B. saxicola* and some forms of *B. marginata*—require a period of stratification at about 5 C in order to break their dormancy (Salkin, 1979). No other treatment is needed during germination.

Germination takes place by the radicle emerging through the base of the seed coat followed by elongation of the hypocotyl and raising of the cotyledons. In most cases the seed coat emerges with the cotyledons but with their slight expansion is split and is soon shed. Sometimes the cotyledons are pushed up through the seed coat, so that it remains as a collar about the hypocotyl. This does not appear to be a constant occurrence except in *B. prionotes* and *B. burdettii*.

Figure 2. Seeds of *Banksia* species. Each pair is of one species, showing the inner and outer faces. The scale below is in mm.

A—*B. integrifolia* var. *integrifolia* (A. S. George 13002). B—*B. conferta* var. *penicillata* (A. S. George 14387). C—*B. marginata* (D. McGillivray 3746). D—*B. saxicola* (Not recorded). E—*B. robur* (A. S. George 12992). F—*B. paludosa* (A. S. George 13056). G—*B. solandri* (Not recorded). H—*B. grandis* (A. S. George 14945); right-hand seed is abortive, the seed-body being undeveloped. I—*B. oreophila* (Not recorded). J—*B. quercifolia* (A. S. George 11769).

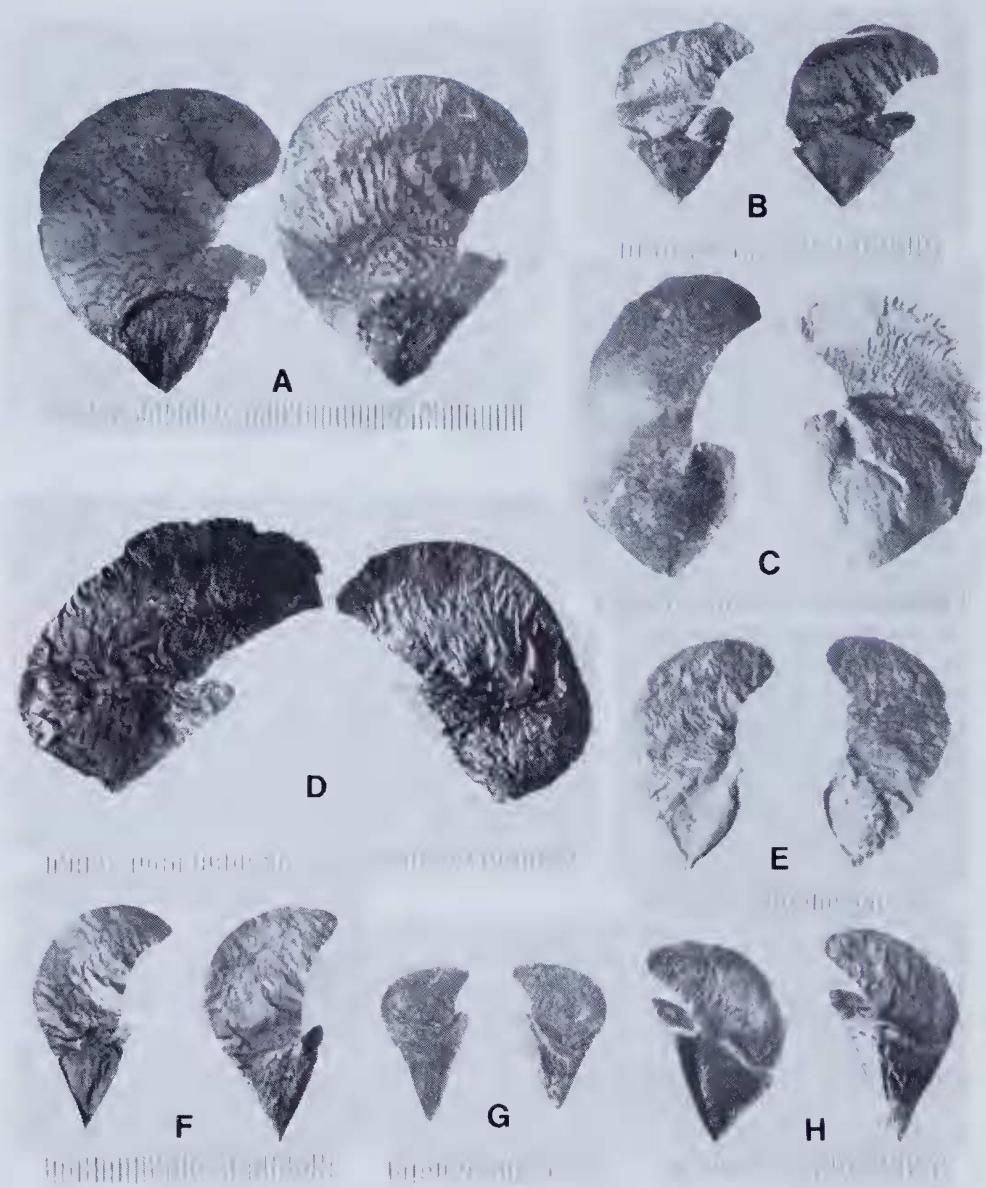
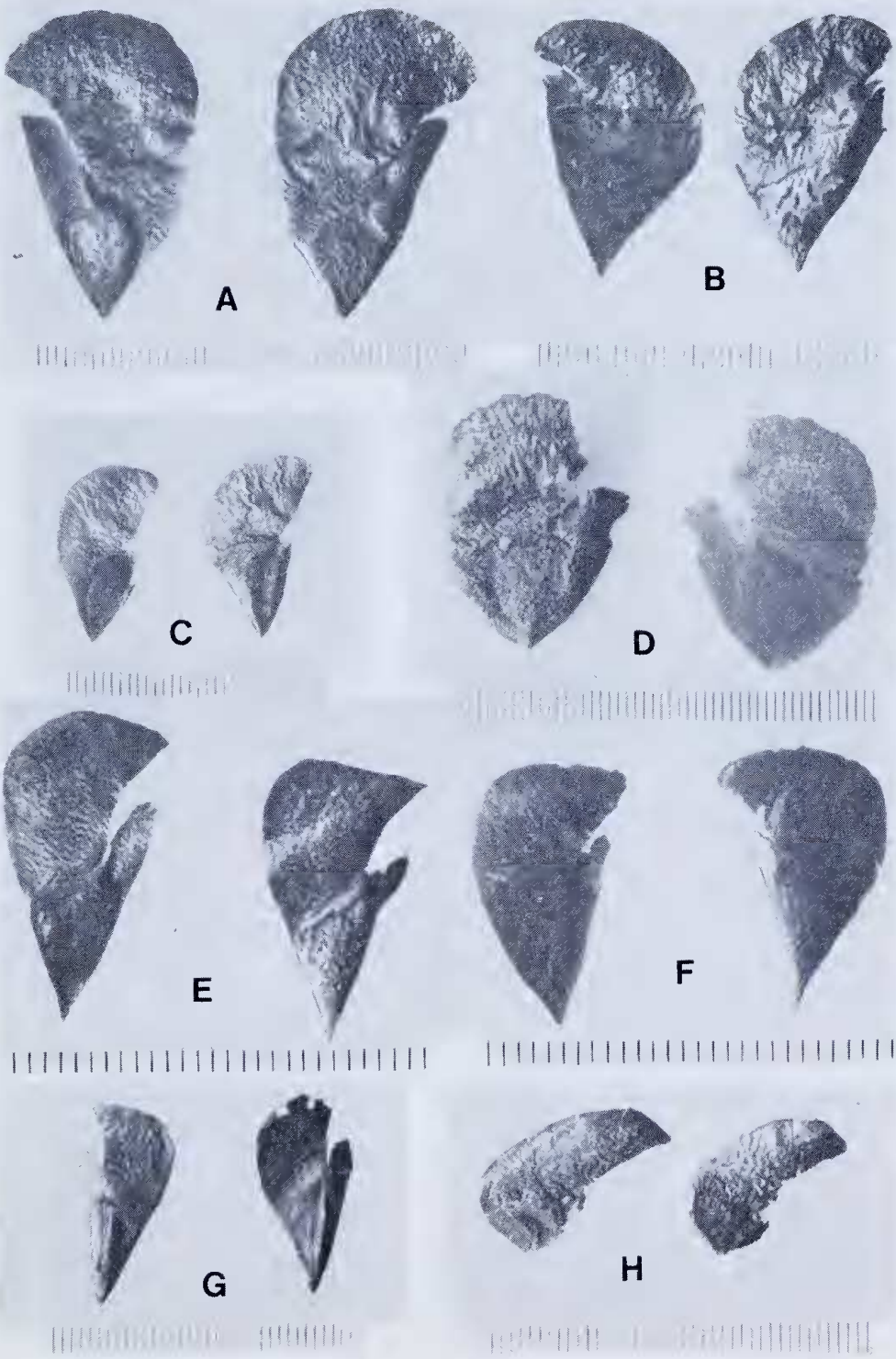


Figure 3. Seeds of *Banksia* species. Each pair is of one species, showing inner and outer faces. The scale below is in mm.

A—*B. aemula* (A. S. George 13024). B—*B. ornata* (A. S. George 13116). C—*B. speciosa* (N of Esperance, W.A., A. S. George s.n.). D—*B. candolleana* (Not recorded). E—*B. sceptrum* (A. S. George 11217: lateral lobe of wing missing). F—*B. victoriae* (E of Kalbarri, W.A., A. S. George s.n.). G—*B. prionotes* (A. S. George 14342). H—*B. hookerana* (Eneabba, W.A., A. S. George s.n.).

Figure 4. Seeds of *Banksia* species. Each pair is of one species, showing inner and outer faces. The scale below is in mm.

A—*B. media* (Not recorded). B—*B. elderana* (SE of Southern Cross, W.A., A. S. George s.n.). C—*B. praemorsa* (Unknown). D—*B. pilostylis* (Unknown, C. A. Gardner). E—*B. beuthamiana* (Not recorded). F—*B. audax* (A. S. George 14315). G—*B. lindleyana* (Binnu, W.A., E. Humphreys s.n.). H—*B. elegans* (Near Lake Indoon, A. S. George s.n.).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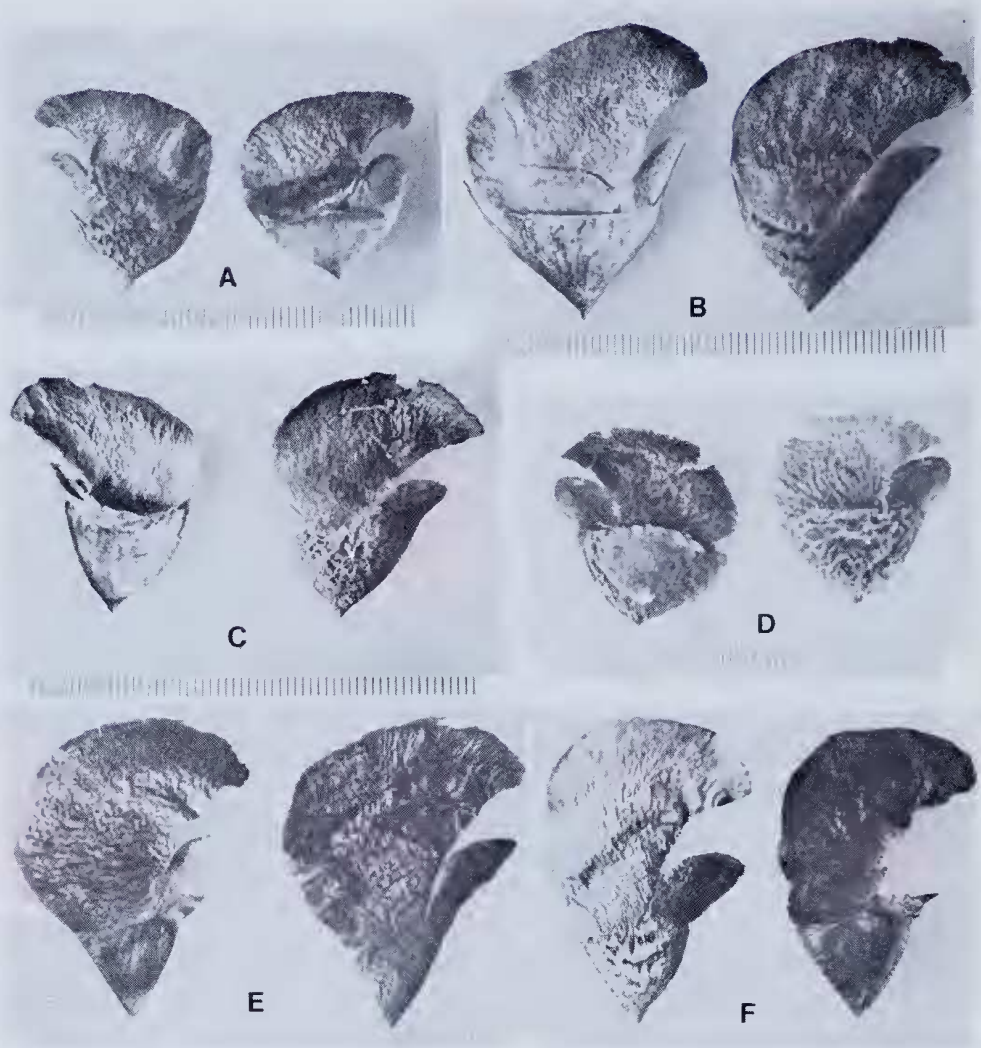
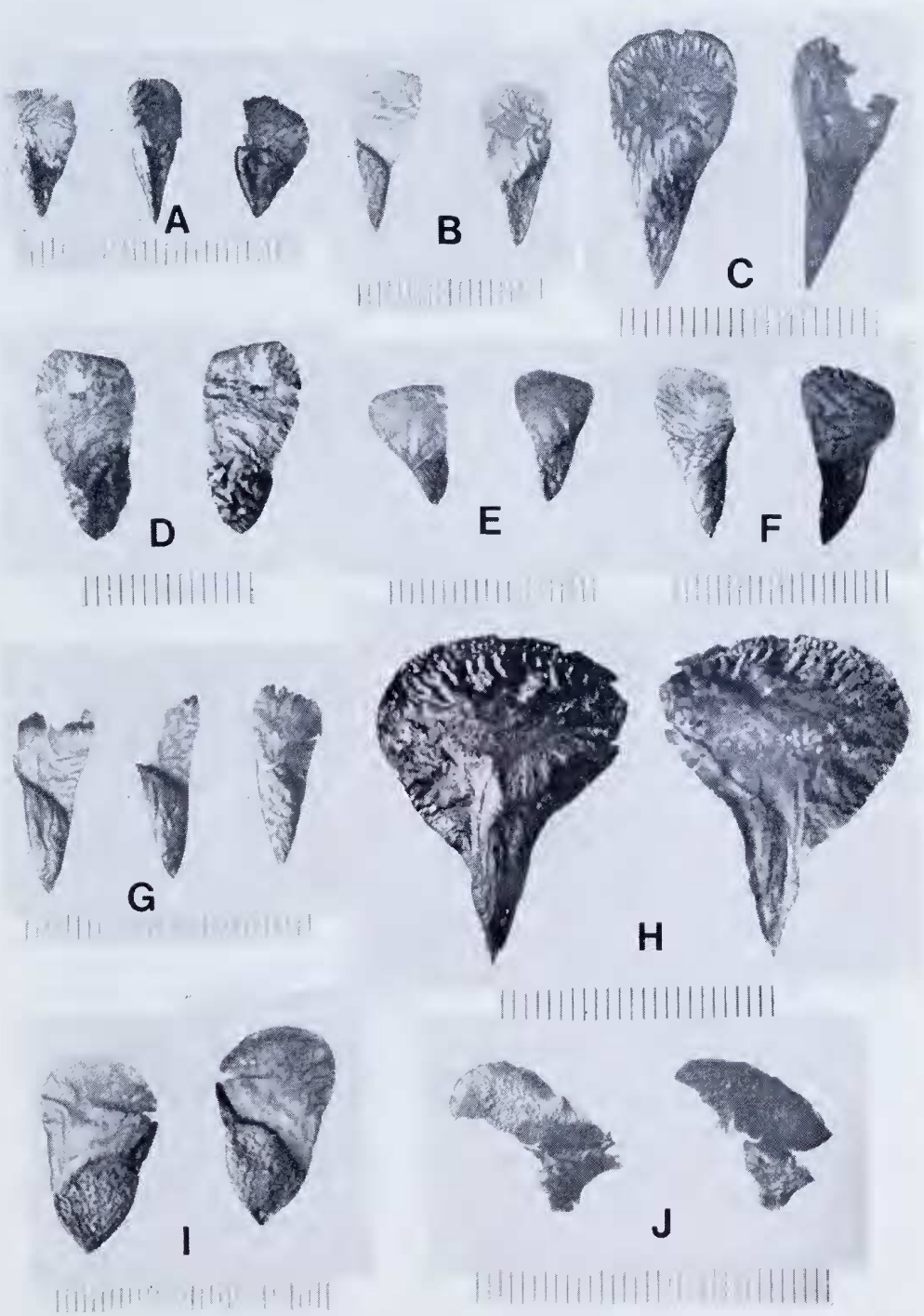


Figure 5. Seeds of *Banksia* species. Each pair is of one species, showing inner and outer faces. The scale below is in mm.

A—*B. goodii* (A. S. George 10884). B—*B. gardneri* var. *brevidentata* (A. S. George 10447). C—*B. chamaephyton* (A. S. George 11190). D—*B. petiolaris* (Not recorded). E—*B. lemanniana* (Not recorded). F—*B. caleyi* (W of Ravensthorpe, W.A., A. S. George s.n.): right-hand seed has lost lateral lobe of wing.

Figure 6. Seeds of *Banksia* species. Each set is of one species, showing inner and outer faces. The scale below is in mm.

A—*B. coccinea* (Unknown, E. Parkin). B—*B. spinulosa* var. *spinulosa* (A. S. George 13051). C—*B. ericifolia* var. *ericifolia* (A. S. George 11790). D—*B. brownii* (N of Albany, W.A., A. S. George s.n.). E—*B. occidentalis* (Unknown). F—*B. littoralis* var. *littoralis* (Gingin Bk., W.A., A. S. George s.n.). G—*B. verticillata* (A. S. George 10880). H—*B. dryandroides* (N of Porongurup Ra., W.A., A. S. George s.n.). I—*B. tricuspis* (Near Mt. Lesueur, E. Parkin s.n.). J—*B. cuneata* (NE of Brookton, W.A., A. S. George s.n.).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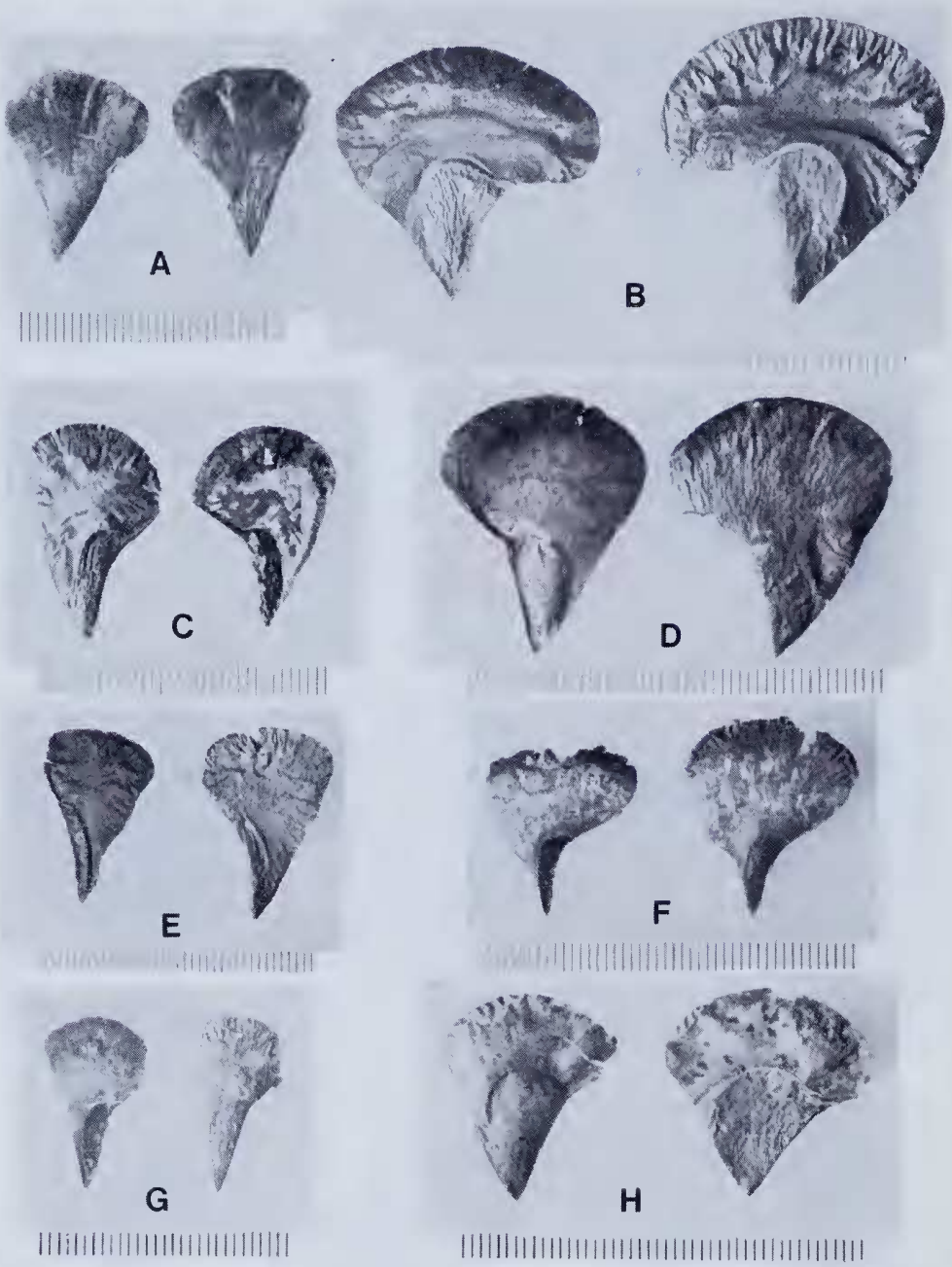

Figure 7. Seeds of *Banksia* species. Each pair is of one species, showing inner and outer faces. The scale below is in mm.

A—*B. sphaerocarpa* var. *sphaerocarpa* (Willyung, W.A., A. S. George s.n.). B—*B. grossa* (Not recorded). C—*B. leptophylla* (A. S. George 7839). D—*B. incana* (Near Mogumber, W.A., A. S. George s.n.). E—*B. violacea* (A. S. George 6083). F—*B. meisneri* var. *meisneri* (A. S. George 11666). G—*B. pulchella* (Not recorded). H—*B. micrantha* (A. S. George 11197).

There is a wide range of form of the cotyledons, many species being determinable at this stage alone. Outlines are shown in Figures 8 and 9. In general the infrageneric classifications of *Banksia* is supported by cotyledon morphology but there are some anomalous species such as *B. repens* and *B. sceptrum*.

Although the character was recorded by Lubbock (1892), no interpretation has been placed on the auricles of the cotyledons which occur not only in *Banksia* but in most Proteaceae. They are formed by united basal lobes and are usually spreading or pendulous. I can offer no explanation for them, except to suggest that they may assist in draining moisture from between the cotyledons.

The cotyledons persist for several months, until at least several seedling leaves have developed. The first two leaves are opposite or almost so, and in several species the succeeding leaves may also be opposite. In most, however, they soon become alternate or scattered but this is apparent only in those species with well-spaced leaves. Many species, e.g. all the Series *Prostratae*, have the seedling leaves crowded immediately above the cotyledons, so that their arrangement may be unclear. Figures 10–15 show some of the range of form of seedling development.

The lignotuber begins development within a year of germination and in most cases is large enough to recover after fire when three years old. It first appears as a swelling in the hypocotyl. The earliest record of this feature in the literature was made by Loddiges (1818) for *B. oblongifolia*, although he gave no interpretation of it. He referred to "many knotty tubercles on the stem, especially near the root, which is frequently enlarged by them into a kind of irregular woody bulb".

The seedling leaves are usually different from those of the adult plant, though in all but a few species this difference is seen only in the first 8–10 leaves. Those in which seedling leaves continue for some time to be different are *B. integrifolia*, *B. conferta*, *B. marginata*, *B. canei*, *B. saxicola*, *B. coccinea*, *B. spinulosa* var. *spinulosa*, *B. verticillata*, *B. tricuspis* and *B. ilicifolia*.

It must be noted that the seedling sample in most cases was less than 15 plants, and that much more work is needed to ascertain what the full variation may be.

Evolution

Banksia or *Banksia*-like pollen has been recorded in Australia as far back as the Palaeocene (Martin, 1978). Fossil leaves referable to *Banksia* have been identified in all States except Western Australia but including Central Australia (Cookson and Duigan, 1950; Christophel and Blackburn, 1978). Fossil fruit are known from Victoria (Cookson and Duigan, 1950) and Western Australia (Anon., 1980). Most of the species described do not match living species, although the fruits from the Kennedy Range, Western Australia, resemble those of *B. attenuata* R. Br. Some leaves from the Yallourn brown coal deposits in Victoria are like those of modern species of the series *Salicinae* and *Orthostylis*.

I believe *Banksia* to have originated under tropical or subtropical conditions, as existed in Australia during the Tertiary. It was clearly widespread across southern Australia before the onset of aridity and the emergence of the Nullarbor Plain, since both sections of the major subgenus, *Banksia*, occur in both the South West and eastern Australia.

In the section *Banksia*, the *Salicinae* contains species which appear the most primitive of the genus, especially *B. dentata*. The series occurs only in northern and eastern Australia, but the series *Grandes* and *Quercinae* may be early derivatives which have developed in the South West.

The series *Orthostylis* probably arose early as it still has representatives in both east and west. In the South West is has given rise to much speciation as seen in the series *Cyrtostylis*, *Prostratae*, *Tetragonae* and *Crocinae*. The *Coccineae*, containing only *B. coccinea*, is an enigma, without clear links with any other series.

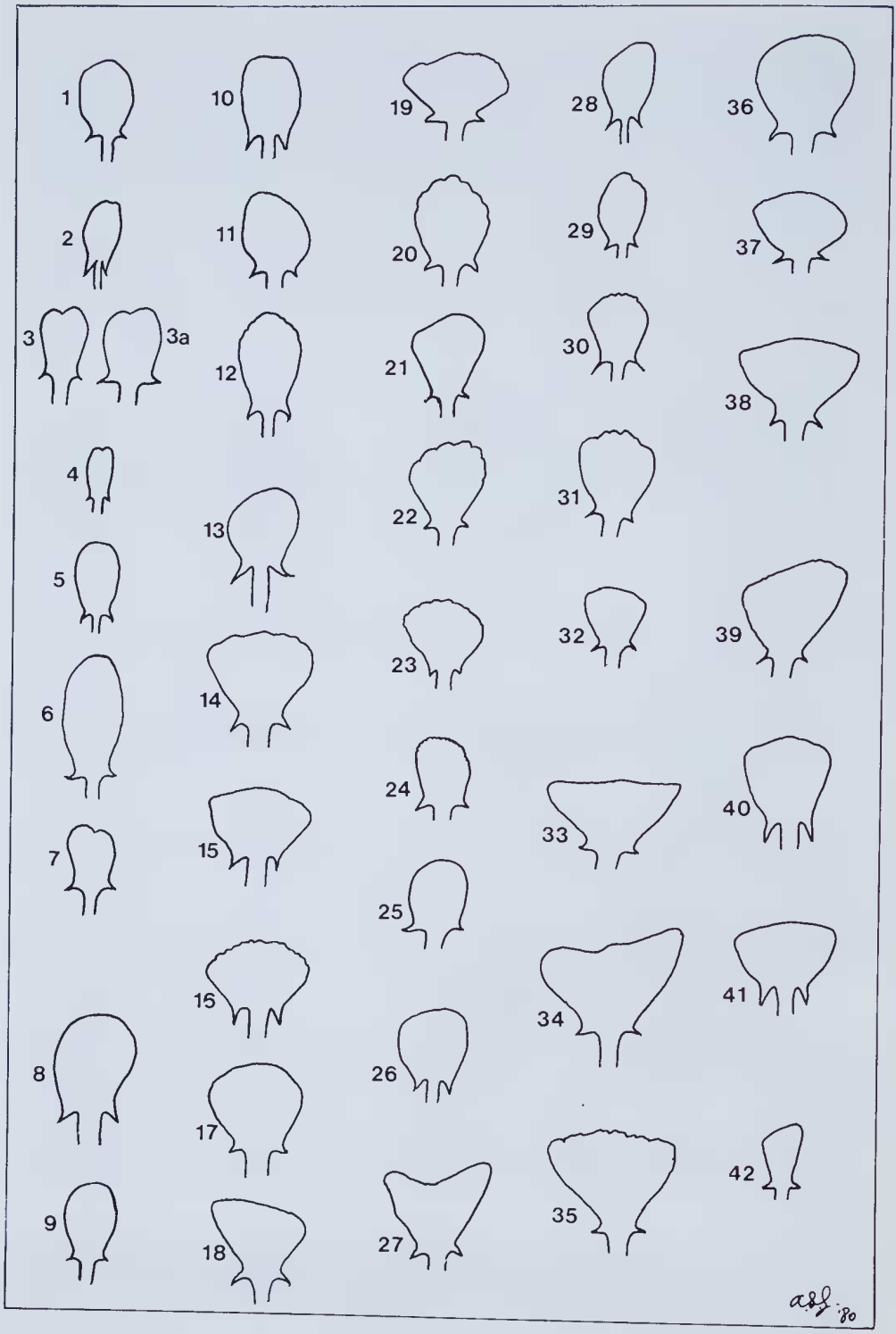
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Figure 8. Outlines of cotyledons of *Banksia* species. All are approximately natural size.
1—*B. dentata* (Darwin, N.T., C. Dunlop). 2—*B. integrifolia* var. *integrifolia* (A. S. George 13002). 3—*B. conferta* var. *penicillata* (A. S. George 14387). 3A—*B. conferta* var. *conferta* (Glasshouse Mts., Qld., A. S. George s.n.). 4—*B. marginata* (A. S. George 13102). 5—*B. oblongifolia* (A. S. George 13027). 6—*B. robur* (A. S. George 12987). 7—*B. paludosa* (A. S. George 13056). 8—*B. grandis* (Spearwood, W.A., A. S. George s.n.). 9—*B. solandri* (Unknown, ex Kings Park, W.A.). 10—*B. quercifolia* (A. S. George 11769). 11—*B. oreophila* (E Mt. Barren, W.A., A. S. George s.n.). 12—*B. baueri* (From cultivated plant, A. S. George s.n.). 13—*B. serrata* (A. S. George 11792). 14—*B. aemula* (A. S. George 13034). 15—*B. ornata* (A. S. George 13116). 16—*B. menziesii* (Jandakot, W.A., A. S. George s.n.). 17—*B. speciosa* (Esperance, W.A., A. S. George s.n.). 18—*B. baxteri* (South Stirling, W.A., A. S. George s.n.). 19—*B. candolleana* (A. S. George 14407). 20—*B. sceptrum* (A. S. George 11217). 21—*B. prionotes* (Shenton Park, W.A., A. S. George s.n.). 22—*B. victoriae* (E of Kalbarri, W.A., A. S. George s.n.). 23—*B. burdettii* (Unknown, ex Kings Park). 24—*B. media* (A. S. George 9332). 25—*B. praemorsa* (Unknown, cult. PERTH). 26—*B. pilostylis* (A. S. George 13121). 27—*B. attenuata* (S Guildford, W.A., A. S. George s.n.). 28—*B. ashbyi* (N of Northampton, W.A., A. S. George s.n.). 29—*B. benthamiana* (A. S. George 11177). 30—*B. andax* (A. S. George 14315). 31—*B. lullfitzii* (Unknown, W.A., per G. Lullfitz). 32—*B. elderana* (SE of Southern Cross, W.A., A. S. George s.n.). 33—*B. goodii* (A. S. George 10884). 34—*B. gardneri* var. *brevidentata* (A. S. George 10447). 35—*B. chamaephyton* (A. S. George 11204). 36—*B. repens* (A. S. George 10597). 37—*B. blechnifolia* (A. S. George 10499). 38—*B. petiolaris* (E of Esperance, W.A., G. H. Burvill s.n.). 39—*B. lemanniana* (Fitzgerald R., W.A., A. S. George s.n.). 40—*B. ealeyi* (W of Ravensthorpe, W.A., A. S. George s.n.). 41—*B. aculeata* (Stirling Ra., W.A., A. S. George s.n.). 42—*B. coccinea* (Unknown, ex Kings Park, W.A.).

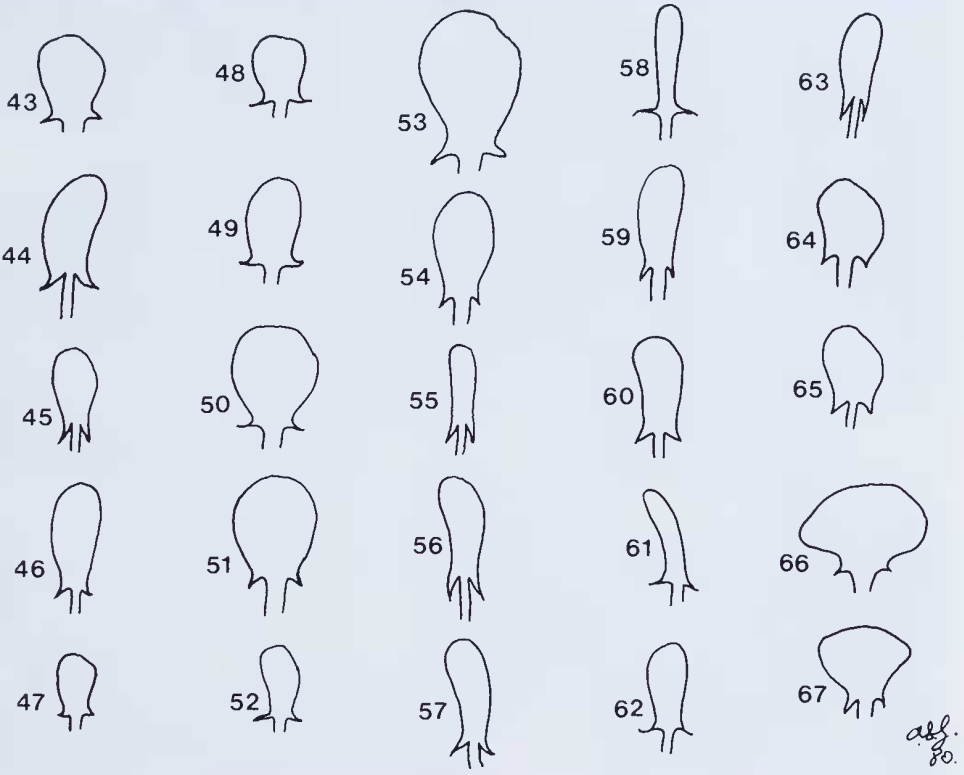


Figure 9. Outlines of cotyledons of *Banksia* species. All are approximately natural size.
43—*B. brownii* (A. S. George 14584). 44—*B. dryandroides* (Unknown, W.A., A. S. George s.n.). 45—*B. spinulosa* var. *spinulosa* (A. S. George 13047). 46—*B. ericifolia* var. *macrantha* (A. S. George 13011). 47—*B. occidentalis* (Unknown, ex Kings Park, W.A.). 48—*B. littoralis* var. *seminuda* (A. S. George 11654). 49—*B. verticillata* (A. S. George 11649). 50—*B. tricuspis* (Unknown, W.A.). 51—*B. sphaerocarpa* var. *sphaerocarpa* (A. S. George 9381). 52—*B. sphaerocarpa* var. *caesia* (E of Lake Grace, W.A., F. W. Humphreys s.n.). 53—*B. micrantha* (A. S. George 14415). 54—*B. grossa* (A. S. George 14428). 55—*B. leptophylla* (A. S. George 10375). 56—*B. lanata* (A. S. George 7836). 57—*B. scabrella* (A. S. George 10374). 58—*B. tenuifolia* (Cannington, W.A., A. S. George s.n.). 59—*B. laricina* (Regans Ford, W.A., R. Cranfield s.n.). 60—*B. incana* (A. S. George 11193). 61—*B. violacea* (Near Fitzgerald R., W.A., A. S. George s.n.). 62—*B. meisneri* var. *ascendens* (A. S. George 14231). 63—*B. pulchella* (Esperance, W.A., A. S. George s.n.). 64—*B. nutans* var. *nutans* (Esperance, W.A., A. S. George s.n.). 65—*B. nutans* var. *cernuella* (South Stirling, W.A., A. S. George s.n.). 66—*B. ilicifolia* (A. S. George 14583). 67—*B. cuneata* (A. S. George 11205).

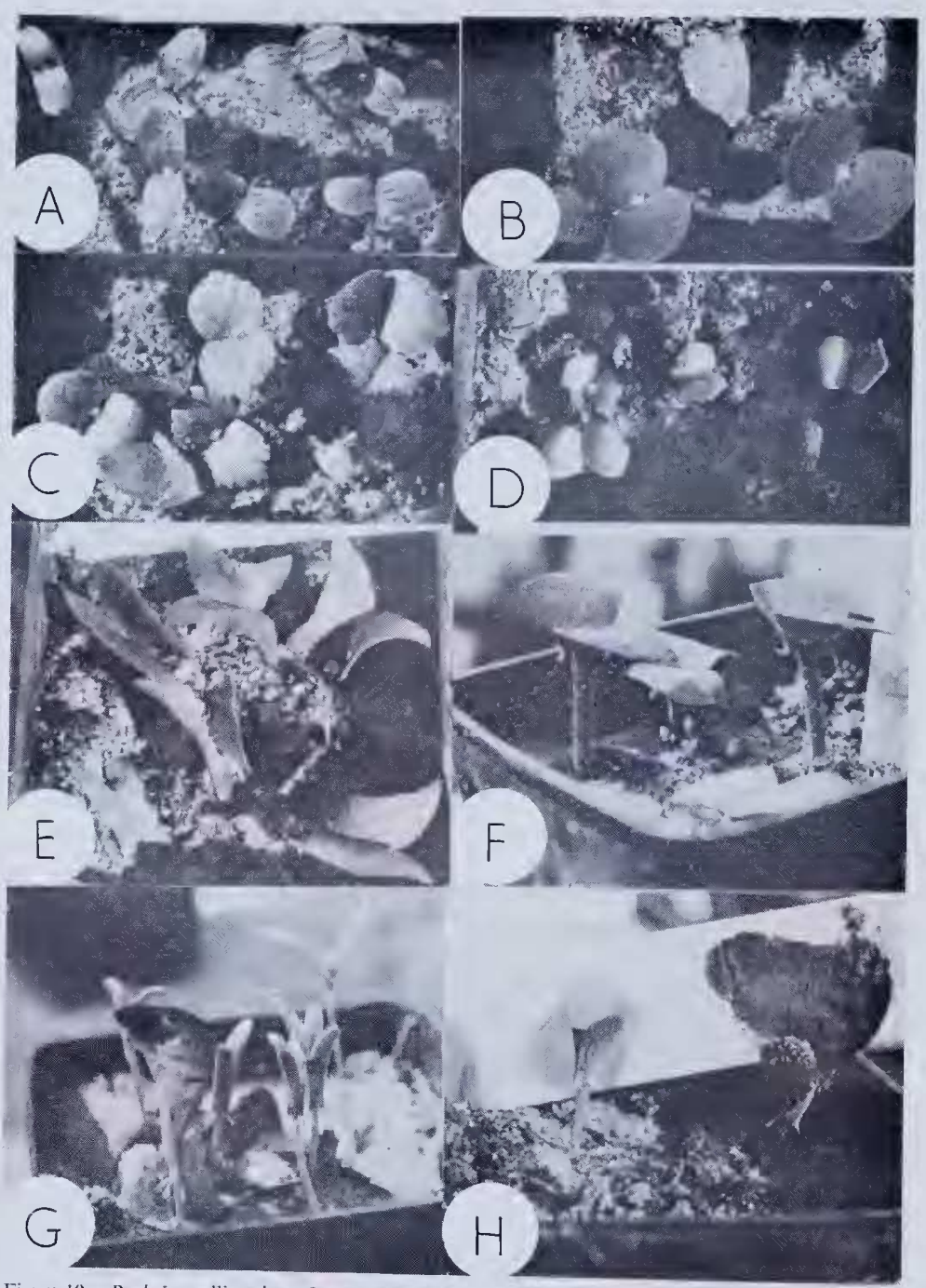


Figure 10. *Banksia* seedlings just after germination.

A—*B. conferta* var. *conferta* (Glasshouse Mts., Qld., A. S. George s.n.). B—*B. speciosa* (Esperance, W.A., A. S. George s.n.): upper plant still has seed-coat enclosing cotyledons. C—*B. sceptrum* (A. S. George 11217). D—*B. prionotes* (A. S. George 14342). E—*B. gardneri* var. *brevidentata* (A. S. George 10447). F—*B. lemanniana* (Fitzgerald R., W.A., A. S. George s.n.). G—*B. violacea* (Twertup Ck., W.A., A. S. George s.n.): front left plant still has seed-coat and wing. H—*B. incana* (A. S. George 11193): right-hand seedling still has seed-coat and wing.

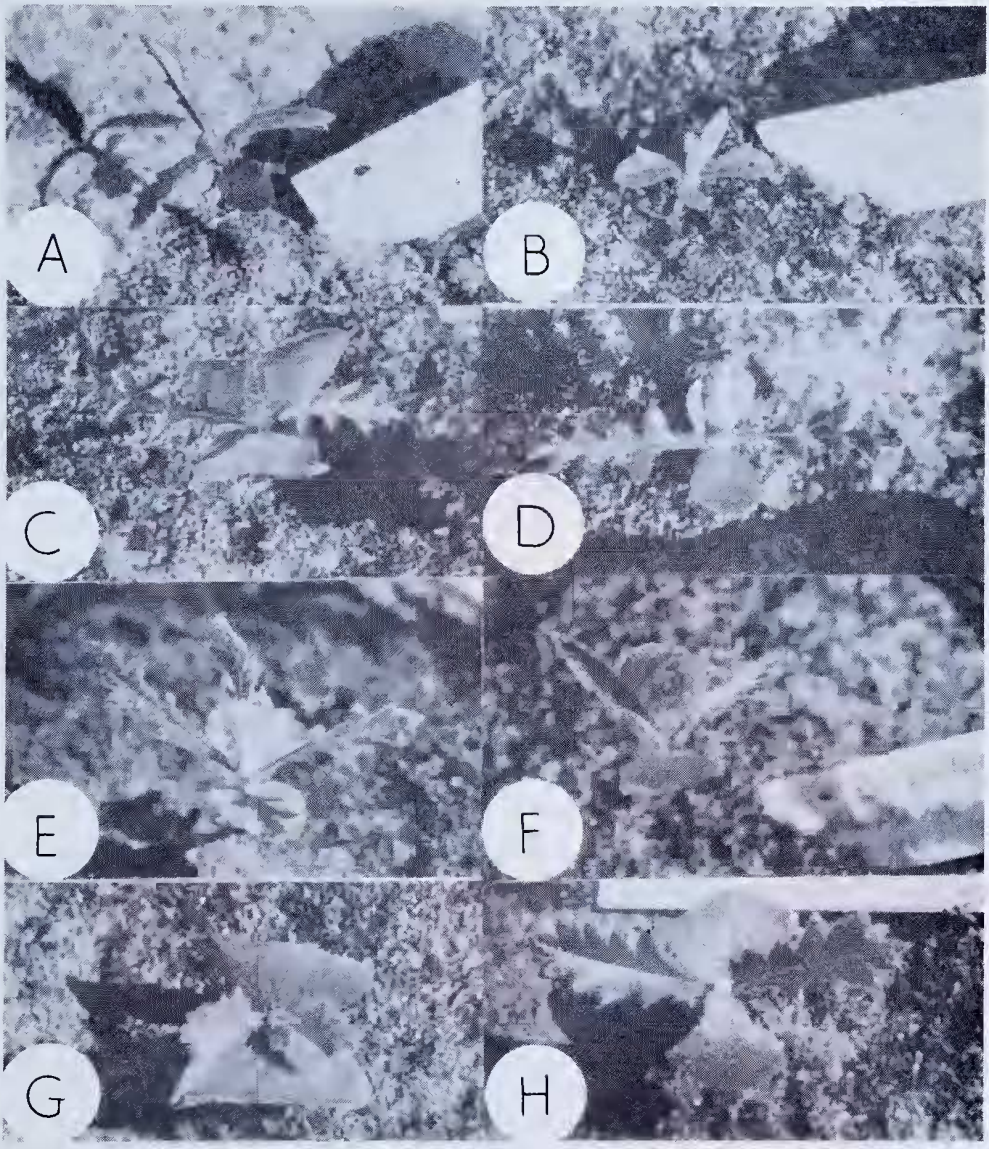


Figure 11. *Banksia* seedlings with first leaves.
A—*B. spinulosa* var. *cunninghamii* (A. S. George 13050). B—*B. integrifolia* var. *integrifolia* (A. S. George 13002). C—*B. attenuata* (W of Mt. Lesueur, W.A., A. S. George s.n.). D—*B. prionotes* (A. S. George 14342). E—*B. sceptrum* (A. S. George 11217). F—*B. pilostylis* (A. S. George 13121). G—*B. gardneri* var. *brevidentata* (A. S. George 10447). H—*B. lemanniana* (Fitzgerald R., W.A., A. S. George s.n.).

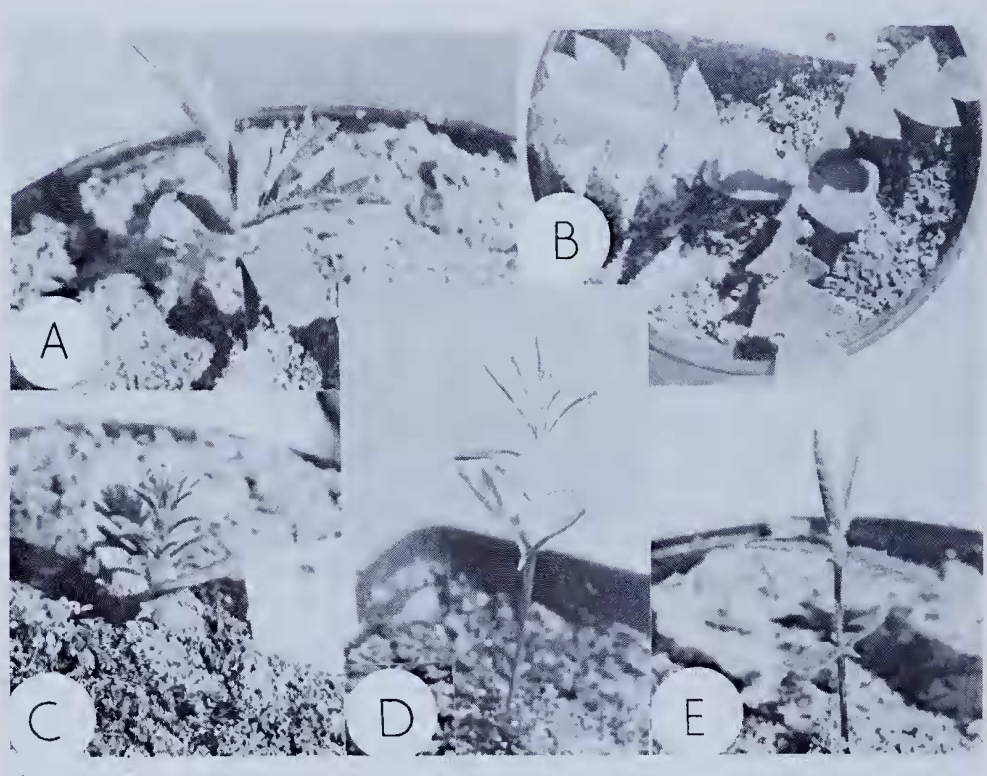


Figure 12. *Banksia* seedlings with first leaves.
A—*B. serrata* (A. S. George 11792). B—*B. grandis* (Spearwood, W.A., A. S. George s.n.). C—*B. micrantha* (A. S. George 11197). D—*B. leptophylla* (A. S. George 10375). E—*B. littoralis* var. *seminuda* (A. S. George 11654).

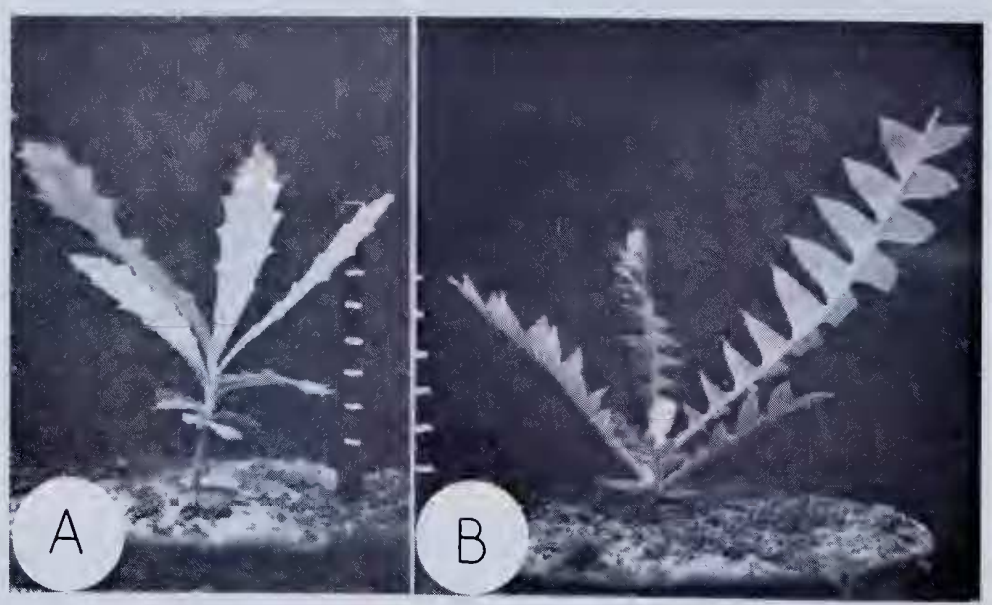


Figure 13.

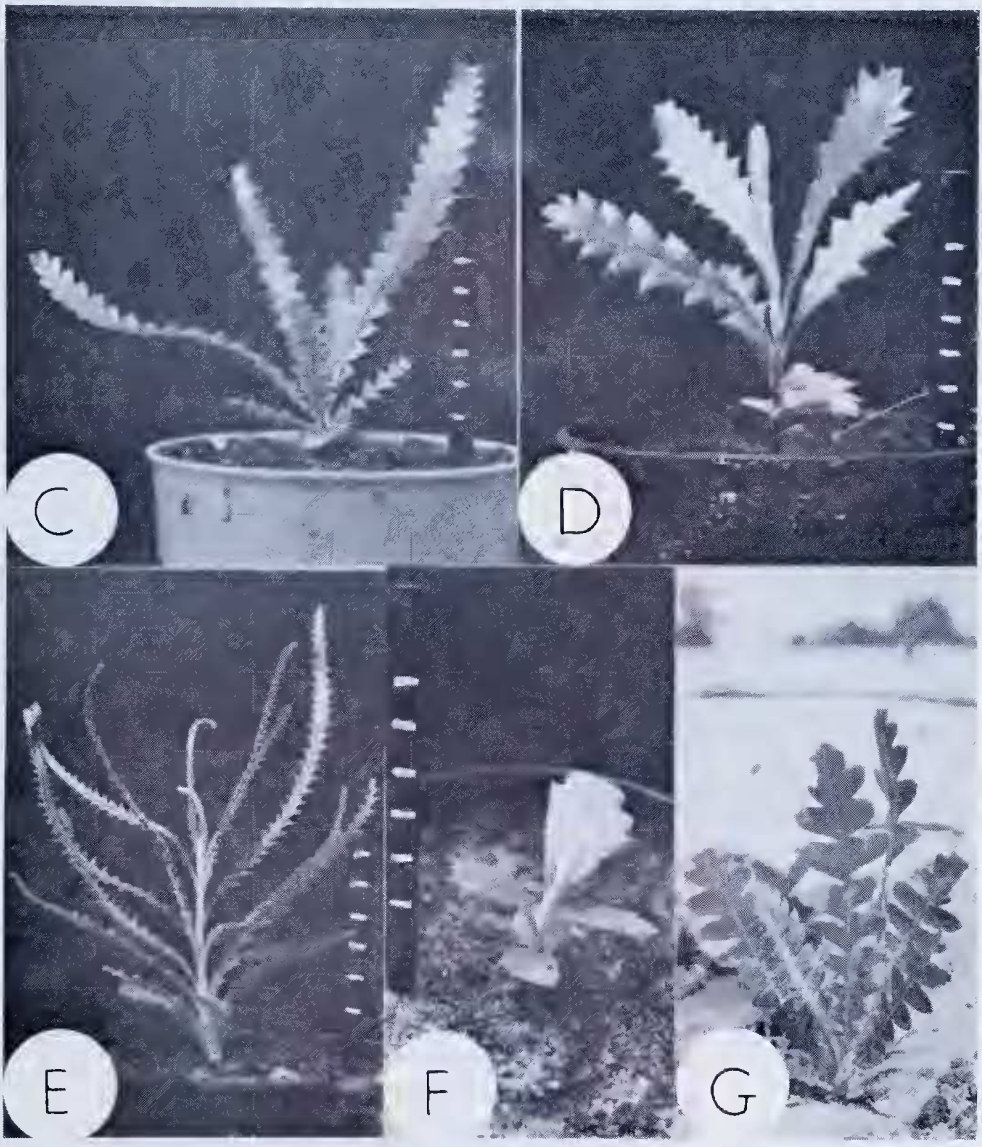


Figure 13. *Banksia* seedlings. Scale in cm.
A—*B. oreophila* (Unknown). B—*B. baxteri* (South Stirling, W.A., A. S. George s.n.). C—*B. menziesii* (Jandakot, W.A., A. S. George s.n.). D—*B. pilostylis* (A. S George 13121). E—*B. attenuata* (A. S George 14420). F—*B. solandri* (A. S. George 11092). G—*B. ilicifolia* (Jandakot, W.A., A. S. George s.n.).

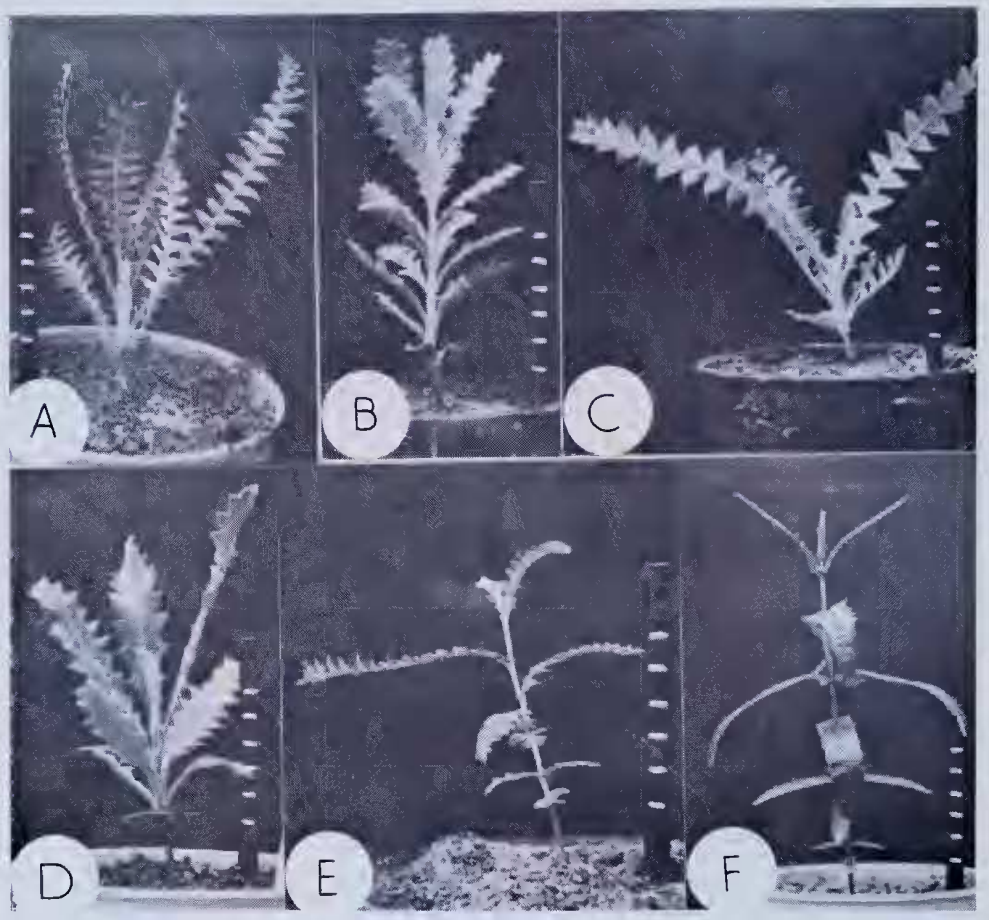


Figure 14. *Banksia* seedlings. Scale in cm.

A—*B. candolleana* (A. S. George 14407). B—*B. sceptrum* (A. S. George 11217). C—*B. victoriae* (E of Kalbarri, W.A., A. S. George s.n.). D—*B. caleyi* (W of Ravensthorpe, W.A., A. S. George s.n.). E—*B. dryandroides* (Albany district, W.A., A. S. George s.n.). F—*B. littoralis* var. *seminuda* (A. S. George 11654).

Section *Oncostylis*—the hooked-style species—must have developed fairly early, certainly before the onset of aridity in the Nullarbor Plain which isolated the South West of Australia. Within the section, the *Spicigerae* is probably the oldest series but several of its taxa may be relatively recent, in particular *B. ericifolia* (both varieties), *B. spinulosa* var. *cunninghamii* and *B. littoralis* var. *seminuda*. The series *Dryandroideae* and *Abietinae* are probably derived from early members of the series *Spicigerae* which became established in the South West. In particular, the *Abietinae* has speciated markedly but in general has remained a closely-knit series.

The subgenus *Isostylis* probably diverged early from a *Salicinae*-like form but has some advanced features such as the closely reticulate venation, abbreviated inflorescence and beaked open follicles.

The possible reasons for the prolific speciation in the flora of the South West of Western Australia has been well analysed by Hopper (1979).

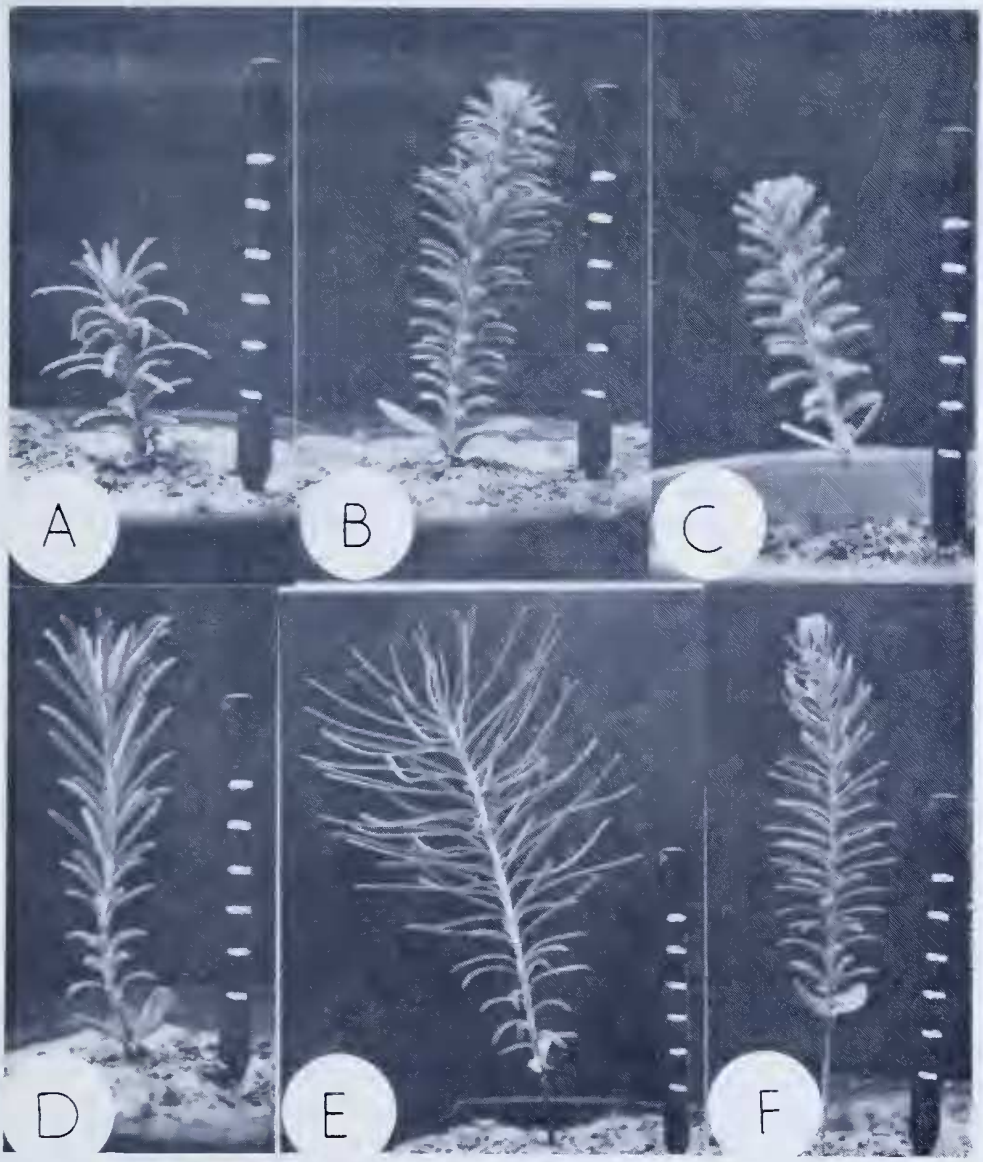


Figure 15. *Banksia* seedlings. Scale in cm.

A—*B. tricuspis* (Mt. Lesueur, W.A., coll. unknown). B—*B. micrantha* (A. S. George 11197). C—*B. violacea* (A. S. George 6089). D—*B. sphaerocarpa* var. *sphaerocarpa* (A. S. George 9381). E—*B. leptophylla* (A. S. George 7839). F—*B. nutans* var. *cernuella* (South Stirling, W.A., A. S. George s.n.).

Table 3 lists character-states considered primitive or derived. These conclusions are based partly on those of Johnson and Briggs (1975) and partly on a subjective assessment.

Table 3

Primitive vs. derived character-states in the genus *Banksia*.

Character	Primitive	Derived
Habit	Tree	Shrub
	Fire-tolerant	Fire-sensitive
Leaves	Spiral or scattered	Whorled
	Flat	Margin revolute
	Dentate	Entire or pinnatisect
Lateral venation of leaves	Openly reticulate with fine nerves and shallow, wide lacunae	Closely reticulate with small, pit-like lacunae
Inflorescence	Terminal to main branchlet	At node or on lateral branchlet
Flower colour	Yellow	Other
Pistil	Straight or gently curved	Hooked at apex
Pollen-presenter	Small, narrow	Larger, modified
Follicle dehiscence	Spontaneous	After fire
Follicle valves	Not split from stylar point	Split leaving a lateral beak
Seed	Without lateral lobe to wing	With lateral lobe to wing
Flowering period	Summer-autumn	Winter-spring

BANKSIA L.f.

Proteaceae

Subfamily **Grevilleoideae** Engl. in Engler and Prantl, Nat. Pflanzenfam. 3, 1: 128 (1888).

Tribe **Banksieae** Reichb., Consp. 82 (1828).

Subtribe **Banksiinae** L. Johnson & B. Briggs, Bot. J. Linn. Soc. 70, 2: 174 (1975).

Banksia L. f., Suppl. 15 (Oct. 1781), nomen conservandum (Sprague, 1940).
Lectotype species: **Banksia serrata** L. f. (Sprague, 1940).

Banksa Cothenius, Disp., 6 (1790)—orthographic variant–*Banksia* L. f.

non *Banksia* Forster & Forster f., Char. Gen. Pl. 7 (1776), nom. rej.—*Pimelea* Banks & Solander ex Gaertner (Thymelacaceae).

nec *Banksea* Koenig, in Retz. Observ. Bot. 3: 63 ("75") (1783) *Costus* Retz. (Zingiberaceae).

nec *Banksia* Bruce, Trav. 73 (1790), (as *Bankesia*, corrected to *Banksia* in tt. 22, 23) *Hagenia* J. F. Gmelin, 1791 (Rosaceae).

nec *Banksia* Dombey ex DC., Prodr. 3: 83 (1828), nomen nudum—*Cuphea* P.Br. (Lythraceae).

Isostylis (R.Br.) Spach, Hist. Nat. Veg. Phan. 10: 402 (March 1841).

Sirmuellera Kuntze, Rev. Gen. Pl. 2: 581 (Nov. 1891).

Shrubs with or without lignotubers, or *trees* with fire-tolerant or fire-sensitive trunks *Branchlets* tomentose, hirsute or glabrous, with or without lenticels; prophylls often present on lower part. *Leaves* spirally arranged, scattered or whorled, petiolate or sessile, coriaceous, dorsiventral; entire, dentate, lobed or pinnatisect; margins flat, recurved or revolute; upper surface when mature smooth, rarely scabrous; lower surface reticulate, with woolly lacunae between the reticulum. *Inflorescence* terminal to a recent branchlet, or at the apex of a previous increment, or on a short lateral branchlet from an older stem; cylindrical or spherical; axis woody, elongated to ovoid; an involucre of bracts at base, persistent or deciduous; flowers in the inflorescence usually about 200 to 3 000, in sessile pairs (unit inflorescences) arranged in vertical rows and with both left- and right-handed spiral pattern; unit inflorescence 2-flowered, subtended by two floral and one common bract. *Perianth* linear, actinomorphic or slightly zygomorphic, the claws straight or slightly curved, limb straight or turned upwards or downwards; limb and claws separating at anthesis except for tube enclosed by bracts. *Anthers* all perfect. *Hypogynous scales* 4, alternate with perianth claws, small, membranous, translucent. *Pistil* terete, slender, straight, bowed or strongly curved below pollen-presenter, rarely sigmoid; often

wiry; pollen-presenter erect, very small and scarcely enlarged to narrowly fusiform, conical or turbinate, sometimes finely costate; stigmatic groove very small, terminal or oblique, rarely the stigmatic surface a small lateral area. *Ovary* sessile, very small, 1-locular; ovules 2, laterally attached. *Infructescence* woody, of few to many follicles; common and floral bracts indurated; follicles woody, variously enlarged and exserted, obtuse. *Seed* obovate, the seed body basal with a terminal membranous wing, the wing entire or with a small lateral lobe. *Separator* between seeds a crustaceous, variously thickened plate with two apical, apposite wings, similar in shape and size to the seed. *Cotyledons* obovate or cuneate, sometimes emarginate, auriculate. First two seedling leaves opposite. *Chromosome number:* n = 14 (Johnson & Briggs, 1975).

Seventy-one species, of which 57 are endemic to South West Western Australia and nearby regions; 13 occur in eastern Australia from Eyre Peninsula (South Australia) to Tasmania and north Queensland, and one occurs across tropical Australia and extends to Papua-New Guinea, Irian Jaya and the Aru Islands. The total known distribution of the genus is given in Fig. 16.

Figure 16. Distribution of the genus *Banksia* L.f. Arrow at upper centre points to the Aru Islands.

The genus is divided into two subgenera, one of which (*Isostylis* R.Br.) contains two species, the other 69 species being further classified into two sections and 12 series. This classification is tabulated as follows:

Subgenus **Banksia**
Section **Banksia**
Series **Salicinae** Meissner 9 species (nos. 1–9)

Series **Grandes** A. S. George 2 species (nos. 10–11)
Series **Quercinae** Meissner 3 species (nos. 12–14)
Series **Orthostylis** (Benth.) A. S. George 8 species (nos. 15–22)
Series **Crocinae** A. S. George 4 species (nos. 23–26)
Series **Cyrtostylis** (Benth.) A. S. George 12 species (nos. 27–38)
Series **Prostratae** A. S. George 6 species (nos. 39–44)
Series **Tetragonae** A. S. George 3 species (nos. 45–47)
Series **Coccineae** A. S. George 1 species (no. 48)
Section **Oncostylis** Benth.
Series **Spicigerae** A. S. George 7 species (nos. 49–55)
Series **Dryandroideae** Meissner 1 species (no. 56)
Series **Abietinae** Meissner 13 species (nos. 57–69)
Subgenus **Isostylis** R.Br. 2 species (nos. 70–71)

Key to the infrageneric taxa of Banksia

1a. Inflorescence of less than 100 flowers, very short and appearing capitate; axis less than 1 cm long; valves of follicles obliquely ovoid ..... subgenus **Isostylis** R.Br.
b. Inflorescence of about 200 to 3 000 flowers, cylindrical, ovoid or spherical; axis 1–30 cm long; valves of follicles semi-elliptic to semi-circular or oblong, rarely obliquely ovoid (subgenus **Banksia**) 2
2a. Pistil below apex straight or sometimes gently curved or sigmoid; development of inflorescence usually acropetal; leaves usually flat with the margins often recurved, lower surface finely reticulate (section **Banksia**) 3
b. Pistil below apex markedly hooked; development of inflorescence usually basi-petal; leaves usually linear with revolute margins, lower surfaces openly reticulate (Section **Oneostylis** (Benth.) A. S. George) 11
3a. Plants prostrate ..... series **Prostratae** A. S. George
b. Plants erect or ascending 4
4a. Inflorescence pendulous; perianth quite straight before anthesis, the limb prominently quadrangular, not relaxed immediately at anthesis; pistil not laterally exserted before anthesis ..... series **Tetragonae** A. S. George
b. Inflorescence erect, rarely pendulous; perianth usually gently curved, the limb terete or somewhat quadrangular, relaxed at anthesis; pistil laterally exserted before anthesis, the limb usually turned upwards 5
5a. Perianth awned ..... series **Quercinae** A. S. George
b. Perianth not awned 6
6a. Inflorescence short; flowers in prominent vertical rows at anthesis; pistil scarlet; pollen-presenter narrowly conical; follicles 6–8 mm long; leaves broadly oblong to obcordate ..... series **Coccineae** A. S. George
b. Inflorescence usually cylindrical to ovoid; vertical arrangement of flowers usually obscure at anthesis; pollen-presenter fusiform, linear, rarely shortly conical; follicles 1–6 cm long; leaves linear, oblong or narrowly obovate 7
7a. Follicles without a lateral beak after opening; pollen-presenter linear, small 8
b. Follicles with lateral beak after opening; pollen-presenter fusiform, shortly conical 9
8a. Leaves usually less than 20 cm long and 4 cm wide, entire to serrate; seeds obovate, usually less than 20 mm long, often with small beak at stylar point ..... series **Salicinae** Meissner
b. Leaves usually 15–45 cm long, 4–12 cm wide, deeply triangular-lobed; seeds cuneate, 20–38 mm long, not beaked ..... series **Grandes** A. S. George
9a. Perianth and pistil bright orange ..... series **Crocinae** A. S. George
b. Perianth yellow, red, or if orange not woolly outside 10

10a. Perianth robust, prominently curved before anthesis; pistil hirsute to finely papillose, stout; pollen-presenter narrowly fusiform with a basal swelling series **Orthostylis** (Benth.) A. S. George

b. Perianth relatively slender, straight or slightly curved before anthesis; pistil glabrous, rarely hirsute, slender; pollen-presenter slightly thickened series **Cyrtostylis** (Benth.) A. S. George

11a. Inflorescence cylindrical; axis usually 8–20 cm long series **Spicigerae** A. S. George

b. Inflorescence spherical to ovoid; axis usually 2–10 cm long 12

12a. Leaves pinnatipartite .... series **Dryandroideae** Meissner

b. Leaves narrowly linear .... series **Abietinae** Meissner

Each of these taxa is described and discussed in the following treatment.

Key to the species of Banksia

1a. Style after anthesis hooked just below apex 2

b. Style straight or curved, occasionally sigmoid at apex, but pollen-presenter always erect 31

2a. Inflorescence oblong, axis 7–20 cm long 3

b. Inflorescence spherical or squat, axis 2–6 cm long 14

3a. Leaves pinnately lobed .... 51. **B. brownii** Baxter ex R.Br.

b. Leaves entire or dentate 4

4a. Leaves narrow-linear; margins revolute, entire or shortly dentate near apices 5

b. Leaves broadly linear, oblong or narrow-elliptic; margins flat to recurved 9

5a. Leaves 9–20 cm long 6

b. Leaves 3–12 cm long 7

6a. Perianth 16–20 (23) mm long, limb pubescent 50A. **B. ericifolia** L.f. var. **ericifolia**

b. Perianth 25–28 mm long, limb hirsute 50B. **B. ericifolia** var. **macrantha** A. S. George

7a. Leaves entire except for an obtuse tooth on each side of the apical mucro; flowers early deciduous; follicles 8–12 mm high, remaining closed 55. **B. tricuspis** Meissner

b. Leaves usually spinulose to dentate at least along upper margins; flowers persistent or early deciduous; follicles 3–7 mm high, opening when mature or remaining closed 8

8a. Leaves in whorls; perianth 13–17 mm long; follicles ± acute along top; western species .... 52. **B. occidentalis** R.Br.

b. Leaves scattered; perianth 25–29 mm long; follicles flattened or rounded on top; eastern species .... 49A. **B. spinulosa** Smith var. **spinulosa**

9a. Leaves elliptic, entire, coriaceous .... 54. **B. verticillata** R.Br.

b. Leaves linear or oblong, usually dentate to some extent 10

10a. Leaves linear, margins recurved 11

b. Leaves broadly linear to oblong 12

11a. Leaves 5–12 cm long; perianth 13–17 mm long; style red 52. **B. occidentalis** R.Br.

b. Leaves 8–20 cm long; perianth 25–27 mm long; style yellow 53A. **B. littoralis** R.Br. var. **littoralis**

12a. Perianth limb glabrous .... 53B. **B. littoralis** var. **seminuda** A. S. George

b. Perianth limb pubescent 13

13a. Leaves white beneath, reticulate venation evident 49B. **B. spinulosa** var. **collina** (R.Br.) A. S. George

b. Leaves pale brown beneath, reticulate venation hidden 49C. **B. spinulosa** var. **cunninghamii** (Sieber ex Reichb.) A. S. George

14a. Leaves triangular-lobed .... 56. **B. dryandroides** Baxter ex Sweet

b. Leaves entire 15

15a. Flowers opening from base upwards, inflorescence pendulous 16
b. Flowers opening from apex down, inflorescence erect 17

16a. Perianth 25-33 mm long; follicles 15-30 mm long, strongly rugose
69A. **B. nutans** R.Br. var. **nutans**
b. Perianth 23-25 mm long; follicles 8-15 mm long, smooth to slightly wrinkled
69B. **B. nutans** var. **cernuella** A. S. George

17a. Leaves scabrous .... 62. **B. scabrella** A. S. George
b. Leaves smooth 18

18a. Perianth glabrous inside 19
b. Perianth pubescent inside 23

19a. Perianth 17-25 mm long; pollen-presenter ovoid 20
b. Perianth 8-10 mm long; pollen-presenter turbinate 21

20a. Leaves 0·5 mm broad; perianth limb pubescent all over; follicle valves with enlarged, thin ridge .... 64. **B. laricina** C. Gardner
b. Leaves 1-2 mm broad; perianth limb mostly glabrous; follicles broad, ± flattened ... . 65. **B. incana** A. S. George

21a. Branchlets glabrous except when very young; perianths soon deciduous
68. **B. pulchella** R.Br.
b. Branchlets tomentose; perianths persistent for some years 22

22a. Leaves reflexed, 3-7 mm long .... 67A. **B. meisneri** Lehm. var. **meisneri**
b. Leaves erect or spreading, 5-12 mm long
67B. **B. meisneri** var. **ascendens** A. S. George

23a. Pistil 50-65 mm long .... 57C. **B. sphaerocarpa** var. **dolichostyla** A. S. George
b. Pistil 19-45 mm long 24

24a. Perianth 22-25 mm long 25
b. Perianth 30-45 mm long 27

25a. Common bracts 7-8 mm long; perianth limb 4 mm long; follicles 4-7 mm wide, erect, hirsute .... 63. **B. telmatiaea** A. S. George
b. Common bracts 2·5-4 mm long; perianth limb 2-3 mm long; follicles 8-23 mm wide, ± flattened, closely pubescent becoming glabrous 26

26a. Flowers pale yellow; limb almost glabrous; follicles not viscid
58. **B. micrantha** A. S. George
b. Flowers greenish-violet; limb pubescent throughout; follicles ± viscid
66. **B. violacea** C. Gardner

27a. Common bracts white ... . 61. **B. lanata** A. S. George
b. Common bracts ferruginous 28

28a. Leaves 1·8-2·8 mm broad .... 59. **B. grossa** A. S. George
b. Leaves 1-1·5 mm broad (rarely broader) 29

29a. Branchlets tomentose; leaves soft; common bracts 7-10 mm long; perianth limb 5-6 mm long; follicles 7-14 mm wide, valves ± smooth but hirsute
60. **B. leptophylla** A. S. George
b. Branchlets pubescent but soon glabrous; leaves ± stiff, pungent; common bracts 6-7 mm long; perianth limb 3-4 mm long; follicles 10-25 mm wide, transversely shouldered, hirsute becoming glabrous 30

30a. Leaves green or slightly glaucous; follicles 15-30 mm long, 15-25 mm wide
57A. **B. sphaerocarpa** R.Br. var. **sphaerocarpa**
b. Leaves glaucous; follicles 10-15 mm long, 10-15 mm wide
57B. **B. sphaerocarpa** var. **caesia** A. S. George

31a. Axis compresseed-ovoid, 5-30 mm long 32
b. Axis elongate, usually over 3 cm long 34

32a. Leaves obovate-cuneate, acutely dentate, green; inflorescence head-like 33
b. Leaves broadly linear, regularly lobed, 15-30 cm long, glaucous; inflorescence compressed-ovoid .... 38. **B. elegans** Meissner

33a. Leaves 4-8 cm long, undulate .... 70. **B. ilicifolia** R.Br.
b. Leaves 1-3 cm long, ± flat .... 71. **B. cuneata** A. S. George
34a. Perianth awned 35
b. Perianth not awned 37
35a. Perianth 58-65 mm long; style shortly sigmoid at apex .... 14. **B. baueri** R.Br.
b. Perianth 20-29 mm long; style ± straight 36
36a. Perianth ferruginous; leaves ± regularly dentate, undulate: follicles 5-7 mm wide .... 12. **B. quercifolia** R.Br.
b. Perianth pink-mauve; leaves entire to sparsely dentate, ± flat; follicles 14-20 mm wide .... 13. **B. oreophila** A. S. George
37a. Style prominently sigmoid below apex .... 22. **B. sceptrum** Meissner
b. Style straight or curved 38
38a. Stems prostrate 39
b. Stems erect 46
39a. Leaves dentate 40
b. Leaves pinnatipartite 42
40a. Leaves white-tomentose below; perianth cream, often pink-tinged 44. **B. petiolaris** F. Muell.
b. Leaves glabrous below except in lacunae; perianth ferruginous 41
41a. Leaves 4-8 cm wide, dentation often irregular; involucral bracts 2-4 cm long very hirsute .... 39. **B. goodii** R.Br.
b. Leaves 2-3 cm wide, dentation regular; involucral bracts 1-3 cm long, shortly hirsute .... 40B. **B. gardneri** var. **brevidentata** A. S. George
42a. Stems underground; leaf lobes ± cuneate, irregularly dentate.... 42. **B. repens** Labill.
b. Stems on surface, rarely underground; leaf lobes entire 43
43a. Leaves bluish-green; perianth 28-30 mm long, red-pink; claws loosely pubescent with short, curled hairs .... 43. **B. blechnifolia** F. Muell.
b. Leaves deep or pale green; perianths 22-30 mm long, ferruginous or cream and pink; claws hirsute with spreading hairs 44
44a. Leaves divided almost to midrib; lobes 3-8 cm long; Mogumber-Eneabba 41. **B. chamaephyton** A. S. George
b. Leaves divided 1/2–2/3 way to midrib; lobes 1–3 cm long; Albany-Ravensthorpe 45
45a. Perianth ferruginous; Albany-Stirling Range 40A. **B. gardneri** A. S. George var. **gardneri**
b. Perianth pale brown; Borden-Ravensthorpe 40C. **B. gardneri** var. **hiemalis** A. S. George
46a. Perianth glabrous 47
b. Perianth pubescent, hirsute or villous at least on the claws 52
47a. Inflorescence pendulous 48
b. Inflorescence erect 50
48a. Leaves dentate, lobes 1–3 mm long .... 45. **B. lemanniana** Meissner
b. Leaves pungently lobed, lobes 4–10 mm long 49
49a. Leaf margins ± recurved, lobes 4-6 mm long with rounded sinuses; perianth deep dull red .... 46. **B. caleyi** R.Br.
b. Leaf margins ± flat; lobes 5–10 mm long with angular sinuses; perianth cream tending to reddish on lower parts of claws 47. **B. aculeata** A. S. George
50a. Leaves cuneate 3–5 cm long with a few obtuse teeth; perianth maroon 28. **B. praemorsa** Andrews
b. Leaves linear, 6–10 cm long with many teeth; perianth yellow 51
51a. Perianth 15–22 mm long; styles curled against axis after flowering 30. **B. attenuata** R.Br.
b. Perianth 35–43 mm long; styles remaining erect from axis, rigid 31. **B. lindleyana** Meissner

52a. Style hirsute .... 29. **B. pilostylis** C. Gardner
b. Style glabrous 53

53a. Leaves (3) 4–10 cm wide 54
b. Leaves usually less than 3 cm wide 60

54a. Leaves shortly dentate with many teeth 55
b. Leaves with large triangular lobes 57

55a. Leaves obovate-orbicular, 3–6 cm long; perianth 20–25 mm long, villous; style scarlet; follicles 1–3 mm high .... 48. **B. coccinea** R.Br.
b. Leaves obovate-oblong, 9–25 cm long; perianth 25–30 mm long, silky-pubescent; style yellow; follicles 3–8 mm high 56

56a. Leaves very undulate, white-tomentose below, dentation ± irregular, 5–10 mm long; follicles 5–8 mm high, opening within a year; tropical species 1. **B. dentata** L.f.
b. Leaves ± flat, pale green-tomentose below, dentation ± regular, 2–3 mm long, venation regular; follicles 3–5 mm high, remaining closed for several years; Atherton-Sydney .... 8. **B. robur** Cav.

57a. Leaf lobes rounded; perianth brown-purple, hirsute; Stirling Range 11. **B. solandri** R.Br.
b. Leaf lobes angular; perianth pale yellow and pubescent, or orange and villous 58

58a. Leaf lobes 4–7 per side; inflorescence rounded, axis 4–5 cm long 20. **B. baxteri** R.Br.
b. Leaf lobes 8–20 per side; inflorescence oblong, axis 10–30 cm long 59

59a. Leaves 6–10 cm wide, lobes 8–12; perianth pale yellow, limb glabrous; follicles scarcely exserted from massive cone, old flowers deciduous 10. **B. grandis** Willd.
b. Leaves 3–4 cm wide, lobes 16–20; perianth orange, villous throughout; follicles exserted but hidden within persistent old flowers 24. **B. victoriae** Meissner

60a. Perianth white-villous, orange inside; style orange 61
b. Perianth pubescent or hirsute, or if villous then not white; style variously coloured 64

61a. Leaves 6–10 mm wide .... 25. **B. hookerana** Meissner
b. Leaves 1·5–3 cm wide 62

62a. Leaves shortly dentate, teeth 1–2 mm long .... 26. **B. burdettii** E. G. Baker
b. Leaves triangular-lobed, lobes 2–15 mm long 63

63a. New leaves and involucral bracts very woolly; leaf lobes 10–15 mm long; old flowers persistent in fruit .... 24. **B. victoriae** Meissner
b. New leaves and involucral bracts pubescent-hirsute; leaf lobes 2–5 mm long; old flowers deciduous .... 23. **B. prionotes** Lindley

64a. Leaves usually entire 65
b. Leaves usually dentate or lobed 71

65a. Leaves linear to lanceolate, scattered 66
b. Leaves elliptic to obovate, in whorls 68

66a. Leaves pungent, 2–4 cm long; follicles densely tomentose, remaining closed for some years .... 5. **B. canei** J. H. Willis
b. Leaves acute to truncate, 3–20 cm long; follicles closely tomentose or loosely hirsute, usually opening when mature 67

67a. Leaves narrow-elliptic, 10–20 cm long, acute; perianth 25–29 mm long; Townsville to Cooktown .... 2C. **B. integrifolia** var. **aquilonia** A. S. George
b. Leaves linear or oblong 3–6 cm long, obtuse or truncate; perianth 17–19 mm long; S.A., Vic., Tas., N.S.W. .... 4. **B. marginata** Cav.

68a. Involucral bracts 10–20 mm long; perianths persistent in fruit; follicles 2–5 mm high, 3–5 mm thick, remaining closed for several years; SE Qld. 3A. **B. conferta** A. S. George var. **conferta**
b. Involucral bracts 2–10 mm long; perianths early deciduous; follicles 3–8 mm high 69

69a. Perianth 19–22 mm long; follicles remaining closed for several years, lip 2–3 mm wide; Grampians and Wilsons Promontory 6. **B. saxicola** A. S. George
b. Perianth 22–25 mm long; follicles opening within a year of anthesis, lip 0·5–1·5 mm wide; widespread, Melbourne to Mackay 70

70a. Leaves 4–10 cm long, ± flat, usually dull green above 2A. **B. integrifolia** L.f. var. **integrifolia**
b. Leaves 10–20 cm long, ± undulate, usually shining above 2B. **B. integrifolia** var. **compar** (R.Br.) Bailey

71a. Leaves (15) 20–40 cm long 72
b. Leaves 2–15 (18) cm long 78

72a. Inflorescence pendulous .... 37. **B. elderana** F.Muell. et Tate
b. Inflorescence erect 73

73a. Leaf margins strongly recurved; perianth 40 mm long .... 19. **B. speciosa** R.Br.
b. Leaf margins flat; perianth 16–35 mm long 74

74a. Leaf lobes separated by shallow sinuses parallel to midrib 75
b. Leaf lobes triangular with V- or U-shaped sinuses; perianth silky-pubescent at least on claws 76

75a. Perianth silky-pubescent, 22–25 mm long; Mullewa to Kulja 33. **B. benthamiana** C. Gardner
b. Perianth shortly villous, 34–49 mm long; E and SE of Southern Cross 36. **B. lullfitzii** C. Gardner

76a. Leaves 2–3 cm wide; axis 7–15 cm long; flowers orange; follicles many 32. **B. ashbyi** E. G. Baker
b. Leaves 1–1·7 cm wide; axis 2–4 cm long; flowers yellow; follicles few 77

77a. Perianth 16–18 mm long, pubescent throughout; follicles 30–50 mm high, 25–45 mm long .... 21. **B. candolleana** Meissner
b. Perianth 32–33 mm long, limb glabrous; follicles 12–18 mm high, 12–20 mm long .... 38. **B. elegans** Meissner

78a. Perianth 30–45 mm long 79
b. Perianth 15–26 mm long 83

79a. Perianth limb glabrous; follicles ± rugose .... 27. **B. media** R.Br.
b. Perianth limb pubescent or hirsute; follicles not rugose 80

80a. Leaves 4–8 (10) cm long; S.A., western Vic. 17. **B. ornata** F. Muell. ex Meissner
b. Leaves 10–15 (18) cm long 81

81a. Leaves oblong, sinuses shallow U-shaped; flowers reddish-pink (rarely yellow or brown), deciduous; follicles mottled; W.A. .... 18. **B. menziesii** R.Br.
b. Leaves narrow-elliptic to obovate, sinuses V-shaped; flowers pale yellow, persistent; follicles evenly grey; Qld. to Tas. 82

82a. Leaves usually 2–4 cm wide; pollen-presenter narrow, 2–3 mm long 15. **B. serrata** L.f.
b. Leaves usually 1·3–2 cm wide; pollen-presenter turbinate, 1 mm long 16. **B. aemula** R.Br.

83a. Leaf margins recurved; eastern species 84
b. Leaf margins quite flat; western species 88

84a. Leaves narrow-obovate to oblong, 4–10 cm long, 1–4 cm broad 85
b. Leaves linear to narrow-oblong, 2–6 cm long, less than 1 cm broad 87

85a. Perianth 16–20 mm long .... 9. **B. paludosa** R.Br.
b. Perianth 24–25 mm long 86

86a. Branchlets hirsute becoming glabrous within a year; common bracts penicillate; perianth closely pubescent .... 3B. **B. conferta** var. **penicillata** A. S. George
b. Branchlets remaining closely tomentose; common bracts not penicillate; perianth shortly hirsute .... 7. **B. oblongifolia** Cav.

87a. Leaves pungent; perianths deciduous; follicles remaining closed for several years .... 5. **B. canei** J. H. Willis
b. Leaves truncate to acute; perianths persistent; follicles usually opening within a year of anthesis .... 4. **B. marginata** Cav.

88a. Leaves 2–6 cm long; perianth 20–23 mm long .... 34. **B. audax** C. Gardner
b. Leaves 8–15 (18) cm long; perianth 22–25 mm long 89

89a. Inflorescence oblong; common bracts truncate; perianth orange, shortly and closely pubescent; Mullewa to Kulja .... 33. **A. benthamiana** C. Gardner
b. Inflorescence spherical; common bracts awned; perianth creamy grey or yellow and brown, hirsute at least on claws; Parker Range to Fitzgerald River 90

90a. Perianth pubescent throughout, cream-grey 35A. **B. laevigata** Meissner subsp. **laevigata**
b. Perianth limb glabrous, golden; claws pubescent, ferruginous 35B. **B. laevigata** subsp. **fuscolutea** A. S. George

Subgenus **Banksia**

Banksiae verae R.Br., Prod. (1810).
Eubanksia Endl., Gen. Plant. Suppl. 4, 2: 88 (1847).—Section *Eubanksia* (Endl.) Meissner in DC., Prodr. 14: 452 (1856).

Inflorescence cylindrical, ovoid or spherical; axis elongated, 1–30 cm long. *Valves* of follicles usually semi-elliptic, semi-circular or oblong, often slightly enlarged on stylar side, but rarely (in *B. elegans*) obliquely ovoid.

Sixty-nine species in 2 sections.

Section **Banksia**

Leaves flat, rarely canaliculate, or the margins often ± recurved, the lower surface finely reticulate between main lateral nerves, the reticulum in mature leaves usually glabrous. Development of inflorescence usually acropetal. *Pistil* straight or sometimes curved, kinked or sigmoid near apex, never hooked. *Follicles* often with lateral beak after opening. *Cotyledons* broadly obovate to cuneate, sometimes emarginate or crenulate.

Forty-eight species in 9 series.

Series **Salicinae** Meissner

in DC., Prod. 14:454 (1856).

Shrubs or *trees* with or without lignotubers or fire-tolerant trunks. *Leaves* whorled or scattered, entire or dentate, glabrous above when mature, white-tomentose below. *Inflorescence* cylindrical; buds usually losing all pattern before anthesis. *Involucral bracts* slender, closely tomentose to villous, deciduous or persistent. *Perianth* ± straight closely pubescent to hirsute, pale yellow, sometimes ferruginous or greenish. *Pistil* straight or slightly curved; pollen-presenter scarcely thickened, 0·5–1 mm long. *Follicles* mostly small, smooth, tomentose, without lateral beak after opening. *Cotyledons* obovate.

Type species: **Banksia integrifolia** L.f. (lecto. nov.).

This series contains 9 species, viz. *B. canei* J. H. Willis, *B. conferta* A. S. George, *B. dentata* L.f., *B. integrifolia* L.f., *B. marginata* Cav., *B. oblongifolia* Cav., *B. paludosa* R.Br., *B. robur* Cav. and *B. saxicola* A. S. George. It is confined to eastern Australia, with *B. dentata* extending to Papua-New Guinea, Irian Jaya and the Aru Islands. Most of the species are very similar to each other morphologically, differing mainly in the leaves and their arrangement and in details of the inflorescence, flowers and follicles. Two species which stand farther apart are *B. robur* in its very large leaves and greenish-yellow flowers and *B. paludosa* in its narrow inflorescences with widely-spaced pale ferruginous flowers.

Apart from *B. dentata* and to a less extent *B. robur*, the species are highly variable. They appear to be actively speciating to occupy different niches in the many habitats available in the region. One of these, *B. canei*, has been recently named, and four other taxa are named in this paper, two as species and two as varieties. The divergence of the disjunct populations of *B. canei* has been discussed by Salkin and Hallam (1978). In spite of this current evolution I consider the *Salicinae* to be the most primitive series

in the genus on account of their unspecialised morphology of leaves, flowers, fruit and seeds. In particular the perianth and pollen-presenter show little modification from what might be expected in an early form of *Banksia*. Further, the follicles open simply on dehiscence, without the development of the lateral beak (caused by the valves splitting from the stylar point) which I consider a derived character. Spontaneous dehiscence of the follicles is probably primitive and occurs consistently in the three most widespread species of the series—*B. dentata*, *B. integrifolia* and *B. marginata*. Flowering in the series is from late summer to early winter which supports the theory of a tropical or sub-tropical origin in a region of summer rainfall.

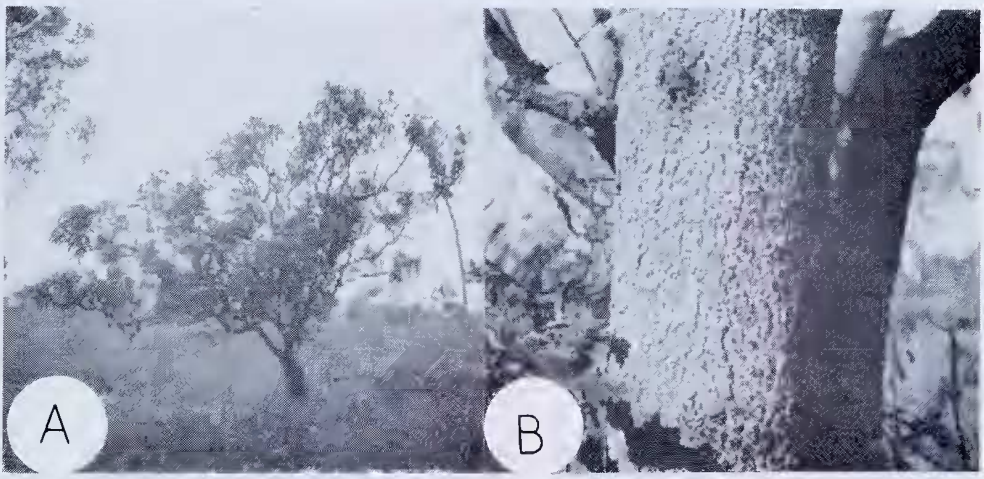


Figure 17. *Banksia dentata*. A—Habit, 6 m tall. B—Bark (A. S. George 12532).

1. Banksia dentata L.f. (Figure 17)

Suppl. 127 (Oct. 1781)—*Isostylis dentata* (L. f.) Britten, Illustr. Austral. Pl. Cook's Voy. 3:84 (1905). *Sirmuellera dentata* (L. f.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "*Habitat* in Nova Hollandia. *J. Banks.*" Lecto (here chosen): BM, a sheet labelled in Banks' hand "New South Wales Endeavour's River J.B."; there is also a printed label ("Plants of Captain Cook's first voyage (H.M.S. Endeavour) 1768–1771. Australia: Queensland Endeavour River 17 June–3 August 1770 Coll. Joseph Banks and Daniel Solander"). There is no specimen of the species in the Linnean Herbarium. Iso: B, BM, MEL, NSW.

Cotyledons (Fig. 8.1) broadly obovate, ascending, 16–19 mm long, 8–11 mm wide, erect, faintly 3-nerved and reticulate, bright green; auricles spreading, acute, 1·5 mm long. *Hypocotyl* 3–4 mm long, 1–1·5 mm wide, glabrous. *Seedling leaves:* first 2 opposite, 3–4 mm above cotyledons, broadly linear, acute, 25–27 mm long, 4–5 mm wide, 2–3-dentate on each side in upper 1/4–1/3, the teeth acute, up to 1 mm long, margins flat; upper surface and midrib below sparsely hirsute; lower surface closely white-woolly; higher leaves scattered, narrowly obovate, 3–7 cm long, 8–12 mm wide, obtuse, mucronate; margins flat, dentate at least distally, the teeth ± 1 mm long, mucronate; upper surface sparsely hirsute, at length glabrous; lower surface closely white-woolly except the glabrous nerves. *Seedling stem* sparsely pubescent and hirsute with white hairs becoming glabrous.

Mature plant a tree to 7 m, usually of irregular shape; trunk moderately stout; crown erect or spreading. *Bark* irregularly tessellated, not friable. *Branchlets* ± striate when young, pubescent with short, curled hairs and hirsute with longer straight ones, all ± ferruginous, eventually turning grey and wearing off; no lenticels; a few prophylls on the lower part of a branchlet, ± triangular, obtuse, 2–4 mm long, velutinous. *Leaves* scattered, those at apex of branchlet ± crowded, narrowly obovate, undulate, obtuse but mucronate, 9–22 cm long, 2–9 cm wide; margins slightly recurved, serrate to dentate

or sometimes entire, the teeth often irregular, 1–13 mm long, apex acute, pungent; sinuses obliquely U-shaped; petiole 5–10 mm long, thick, tomentose; lamina above at first velutinous with ferruginous curled hairs (longer along midrib) becoming glabrous, the midrib and lateral nerves below velutinous becoming glabrous, the broad lacunae closely woolly with white, matted hairs; midrib impressed above, raised below; lateral nerves at 60°–90° to midrib with 1 to each tooth and sinus, often branching, finely reticulate between. *Inflorescence* cylindrical, at apex of 1–3 year old shoot and usually with a whorl of branchlets below, rarely terminal, 7–9 cm wide at anthesis. *Axis* 5–15 cm long, 3–4 mm wide, 15–17 mm wide with common bracts, bearing flowers except for 1–2 cm at base. *Involucral bracts* narrowly triangular to subulate from thickened bases, 2–10 mm long, densely tomentose, pale brown, persistent until fruit. *Common bracts* very narrowly cuneate, 6–7 mm long, densely hirsute, the exserted apex thickened and densely hirsute, pale brown, narrowed to an acute, upturned, white-tomentose point. *Floral bracts* similar but 6 mm long, narrower, the exserted apex smaller, obtuse. *Flowers* cream to pale yellow, including styles. *Perianth* 25–32 mm long including limb of 5 mm; claws 0·5 mm wide above bracts, tapering upwards, outside appressed-pubescent to hirsute except at base, inside glabrous in lower half, then sparsely hirsute; limb narrowly fusiform, appressed-hirsute outside, glabrous inside. *Anthers* ± 2 mm long, prominently apiculate. *Hypogynous scales* linear-oblong, ± 1 mm long, the apex obtuse but ± irregular. *Pistil* 31–46 cm long, ± 0·75 mm thick above ovary, tapering upwards, glabrous; pollen-presenter ± 1 mm long, scarcely distinguishable from style; stigmatic groove terminal; ovary scurfy or brown-papillose around apex with a few hairs on one side. *Infructescence* ± cylindrical but often irregular; perianths and styles soon deciduous. *Follicles* narrowly elliptic in plan view, 15–20 mm long, 4–8 mm high, 5–8 mm wide; valves semi-elliptic, smooth, velutinous to hirsute, pale green becoming pale brown, the hairs wearing off with age; ridge narrow, obtuse; suture fine; follicles opening as soon as mature, to 7–15 mm wide, the valves slightly recurved, the lips 0·75 mm wide in centre widening to 2 mm at sides, dark brown. *Seed* obovate, 18–21 mm long; seed body obliquely obovate, 10–12 mm long, 5–8 mm wide, the stylar side ± straight with an obtuse beak at the stylar point, opposite side convex with the wing somewhat decurrent, base obtuse to acute, the inner surface brown and cream mottled or all dark brown, outer surface slightly rugose, grey-brown; wing 11–14 mm wide, dark brown inside, pale grey-brown outside. *Separator* similar to seed in outline but without beak at stylar point, 17–21 mm long, 13–15 mm wide, brown.

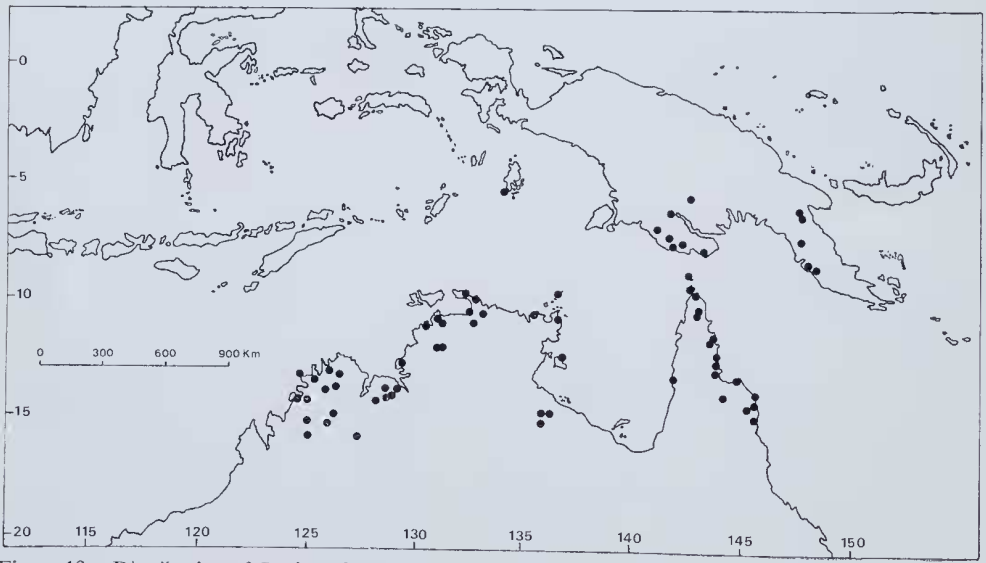


Figure 18. Distribution of *Banksia dentata*.

Distribution. (Fig. 18) Northern Australia, Papua-New Guinea, Irian Jaya and the Aru Islands. In Australia, from Bedford Downs and the Isdell Range in Western Australia through the "Top End" of the Northern Territory to Cape York Peninsula in Queensland, the southern limit there being the Bloomfield River south of Cooktown; there is an apparent gap across the bottom of the Gulf of Carpentaria. In Papua-New Guinea south of 6°S lat., chiefly between the Fly River and Torres Strait, and from Bulolo to Port Moresby. In Irian Jaya one collection seen from the far south east. In the Aru Islands near Trangan. Also on several islands of Torres Strait. The only species of the genus found outside Australia.

Selected collections. ARU ISLANDS: P. Trangan, KP Ngaibor, 3 July 1938, *R. Buwalda* 5479 (K,NBV,S). IRIAN JAYA: Koerick Camp, c. 15 km NE of Koembe village on north bank of Koembe River, 7 Sept. 1954, *P. van Royen* 4864 (K,NBV).

PAPUA-NEW GUINEA: Lake Daviumbu, Middle Fly River, Sept. 1936, *L. J. Brass* 7795 (BRI, NBV), Near Manki Trig Stn, Bulolo, Morobe Distr., 13 Jan. 1950, *E. Gray* 3598 (BRI, CANB,K); Astrolabe Ra. Sogeri Plateau, Central Distr., 11 Feb. 1964, *J. S. Womersley* s.n. (CANB).

WESTERN AUSTRALIA: Between Isdell and Precipice Ranges, May 1905, *W. V. Fitzgerald* 871 (PERTH); Prince Regent River, June 1921, *C. A. Gardner* 1013 (PERTH); Galaxy Swamp, near Drysdale R., in 14°37′S, 126°55′E, 21 Aug. 1975, *A. S. George* 14142 (PERTH).

NORTHERN TERRITORY: 30 miles (48 km) S of McArthur River Stn, 23 July 1948, *R. A. Perry* 1700 (CANB, NT); 20 miles (32km) W of Borroloola, 16 Nov. 1969, *J. R. Maconochie* 863 (NT); Little Lagoon, Groote Eylandt, 10 April 1948, *R. L. Specht* 214 (AD, BRI, MEL, PERTH).

QUEENSLAND: Sanamere Lagoon, Jardine River, Cape York Peninsula, 19 May 1948, *L. J. Brass* 18851 (CANB); Weipa, in 12 40′S, 141 54′E, 22 Jan. 1969, *A. C. van Altena* s.n. (BRI); Between McIvor River and Cape Flattery, in 15°00′S, 145 20′E, 22 Nov. 1972, *A. Dockrill* 622 (QRS).

Habitat. Usually on seasonally moist sandy flats, sometimes with sandstone or quartzite rocks, in open woodland and low woodland with savannah understorey, sometimes by creeks and at the base of gorges; usually at low altitudes, but recorded up to about 1 000 m in Queensland and up to 1 160 m in Papua New Guinea. In Papua New Guinea often on drier slopes and ridges in savannah woodland.

Flowering period. November to June, but to some extent dependent on the rains.

Banksia dentata is the only truly tropical species of the genus and the only species with a distribution extending outside Australia. In spite of its wide geographical range it is remarkably constant in morphology, showing no more variation than occurs in many stable species of the genus. Characteristic features of the species are the small, often irregular arborescent habit; the scattered, large, undulate, dentate leaves, the yellow flowers of somewhat coarse aspect; and the follicles which open when mature. The nearest relative is *B. integrifolia* which typically has whorled, entire, narrowly obovate to lanceolate leaves, pale yellow flowers, shorter styles and smaller follicles. *Banksia dentata* is fire-tolerant, sprouting by epicormic shoots.

2. Banksia integrifolia L.f. (Figure 19)

Suppl. 127 (Oct. 1781)—*Isostylis integrifolia* (L. f.) Britten, Illustr. Aust. Pl. Cook's Voy. 3:83 (1905)—*Sirmuellera integrifolia* (L. f.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "*Habitat* in Nova Hollandia. *I. Banks.*" Lecto (here chosen): LINN (162.5): a specimen labelled in Smith's hand "1) New Holland—*Banks.* H. Lin. fil." Iso: B, BM, C, K, MEL, NSW, US.

Cotyledons (Fig. 8.2) obovate, slightly oblique, emarginate, ⊥ 11 mm long, 6–7 mm wide, + bright green, faintly 3-nerved; auricles spreading or descending, acute, 1·5 mm long. *Hypocotyl* slender, glabrous or arachnoid, green to dark red. *Seedling leaves* oblong, narrowly obovate or narrowly cuneate, obtuse, truncate or emarginate with a mucro less than 1 mm long, the first leaves 1–1·5 cm long, later ones 2–10 cm, 1·5–3·5 cm wide; margins flat, acutely dentate, the lobes obliquely triangular with the distal side shorter, 1–3 mm long, mucronate; upper surface silky-pubescent with pale-ferruginous straight hairs spreading from midrib at a similar angle to the lateral nerves, becoming glabrous; lower surface densely tomentose with crisped, matted, fine white hairs, the nerves obscure except midrib; midrib densely hirsute with pale ferruginous crisped and ± straight hairs, becoming glabrous; petiole 3–5 mm long. *Seedling stem* hirsute. *Juvenile leaves* cuneate to narrowly obovate or lanceolate, truncate or acute, 3–24 cm long, 1–3 cm wide, with a hirsute mucro to 1 mm long, margins almost flat, serrate, (rarely ± entire), the lobes 1–5 mm long, obtuse to mucronate; indumentum as in seedling leaves.

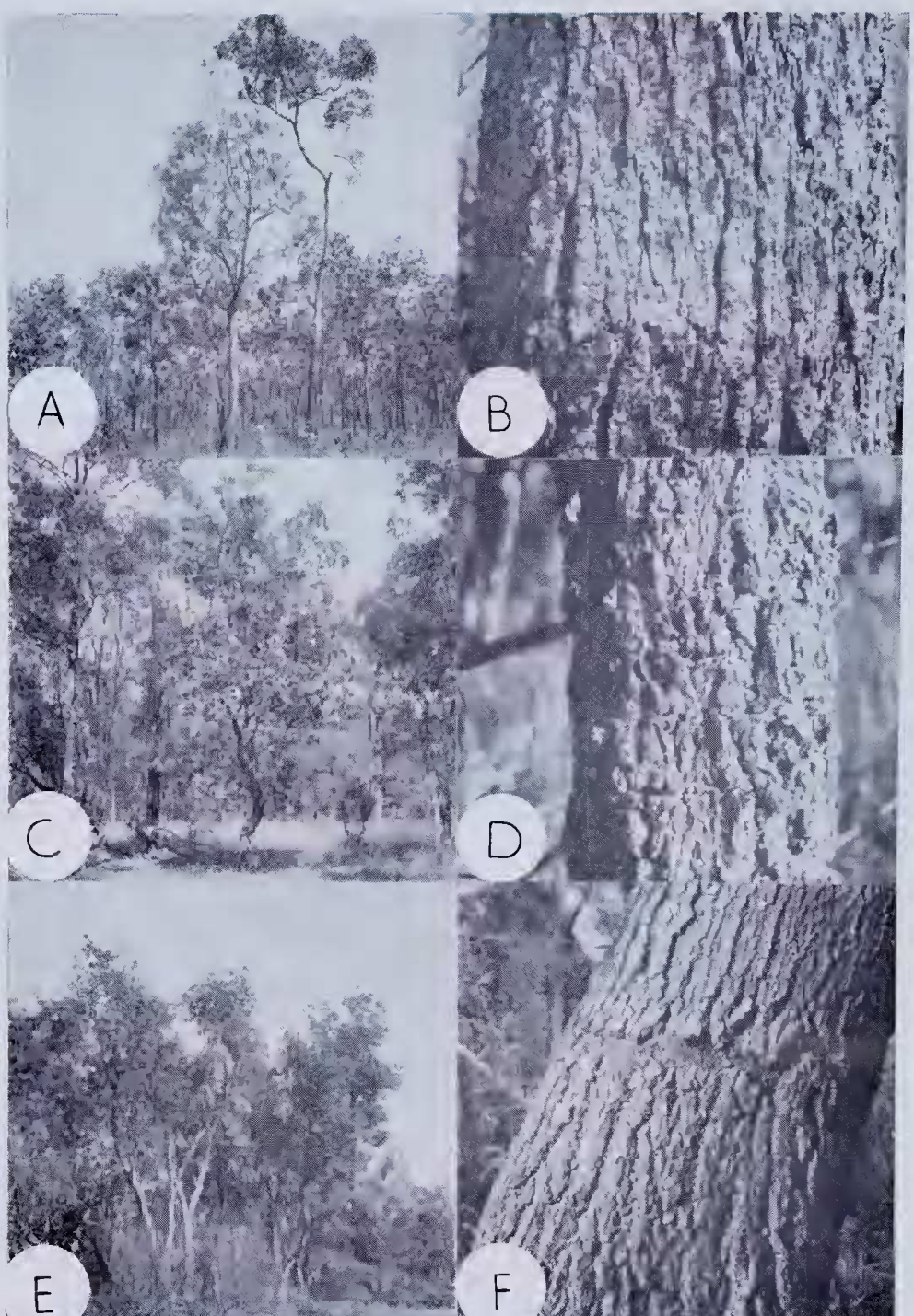


Figure 19. *Banksia integrifolia*. A and B—*B. integrifolia* var. *aquilonia* A—Habit, ± 10 m tall. B—Bark (N of Cardwell, Qld.). C and D—*B. integrifolia* var. *compar* C—Habit, ± 7 m tall. D—Bark (S of Gladstone, Qld.). E and F—*B. integrifolia* var. *integrifolia* E—Habit, ± 15 m tall. F—Bark (Batemans Bay, N.S.W.).

Mature plant a tree of varying stature according to habitat, sometimes to 5 m in exposed situations, to 25 m (rarely taller) where more sheltered, erect or leaning, usually with 1 stem, trunk stout and to 80 cm diam. at base. *Bark* roughly tessellated or fissured, hard, usually not friable, up to 2 cm thick, grey, creamy-pink or brown when cut. *Branchlets* striate, densely pubescent with both short, crisped and long, curved hairs, first the latter and then the former wearing off. *Leaves* in whorls of 3–5, the whorls sometimes slightly oblique or irregular, or the leaves in var. *aquilonia* scattered, mostly in upper half of each shoot, narrowly obovate to narrowly elliptic or lanceolate, obtuse to acute, sometimes emarginate, shortly mucronate, (3)4–20(23) cm long, 6–35 mm wide, entire or with a few obtuse short teeth, flat or the margins slightly recurved, petiole 4–10 mm long: indumentum as in seedling leaves but with few or no long hairs on midrib below (in var. *aquilonia* with persistent hairs on each side of midrib); upper surface dark green, dull or shining; midrib pale yellow or brown. *Inflorescence* cylindrical, 5·5–7 cm wide at anthesis, terminating a branchlet at least one year, usually 2–3 years old, sessile, often with a whorl of several branchlets below; 2 inflorescences may flower in the same season at successive nodes. *Axis* mostly 5–12 cm long, 2·5–4 mm wide, 9–10 mm wide with common bracts. *Involucral bracts* triangular to subulate with thick bases, mostly 2–10 mm long, densely tomentose with crisped, pale brown hairs, many bracts deciduous by the end of flowering. *Common bracts* narrowly cuneate, obtuse (acute in var. *aquilonia*), 3 mm long, densely hirsute with straight, ferruginous hairs; exserted apex thickened, ± conical, slightly upturned, tomentose with pale brown ± crisped hairs. *Floral bracts* similar but narrower, slightly shorter, with less prominent apices. *Flowers* pale yellow, including styles. *Perianth* 22–29 mm long including limb of 3·5–4·5 mm; claws narrowly linear, 0·3–0·4 mm wide, appressed-pubescent outside with straight, white hairs, glabrous inside (in var. *aquilonia* sparsely pubescent); limb elliptic, obtuse, thick, appressed-pubescent with straight, white hairs; perianth relaxed after anthesis, styles projecting 5–13 mm. *Anthers* 2 mm long, connective shortly produced. *Hypogynous scales* linear to oblong, obtuse, ± 1 mm long, free. *Pistil* 27–34 mm long, curved gently downwards then upwards or almost straight, the apex straight; slender, narrowed upwards, glabrous; pollen-presenter scarcely thickened, obtuse, ± smooth when fresh, slightly wrinkled when dried, 0·5–1 mm long; lower half brown, upper cream; stigmatic groove terminal; ovary pubescent in upper half with straight hairs or brown papillae, longer on dorsal and ventral sides, otherwise glabrous. *Infructescence* cylindrical-ellipsoidal, of many follicles, opening in 8–10 months from flowering; bracts somewhat indurated, grey. *Follicles* 7–15 mm long, 3–10 mm high, 3–6 mm wide; valves shallowly convex, smooth, densely tomentose-hirsute with crisped and ± straight hairs sometimes almost glabrous in upper half, pale ferruginous then grey, wearing off apex; ridge obtuse; suture fine; valves opening moderately wide, mostly to 5–9 mm but less or more according to size and crowding, slightly recurved; lips 0·5–1·5 mm wide, dark red-brown; inner surfaces smooth, bright brown. *Seed* obovate, slightly oblique, 10–20 mm long; seed body ± cuneate, 6–10 mm long, 2–5 mm wide, stylar side almost straight, the other curved, dark brownish-black, sometimes with paler flecks, glistening; wing 5–10 mm wide, brown ± glistening or dull, decurrent almost to base on anti-stylar side of seed body. *Separator* similar to seed in shape and size, dull dark brown outside, paler and shining inside.

Banksia integrifolia is one of the most variable species of the genus and gives the impression that it is actively speciating to fill the many ecological niches throughout its range. It spans a wider geographical and climatic range than any other species, from about 15°45′ to 40°S lat.

The general character of the species rests in its arborescent habit; dentate seedling and juvenile leaves; entire mature leaves varying from obovate to lanceolate, mostly 5–20 cm long with a white-tomentose underside; pale yellow cylindrical inflorescences; perianths 22–29 mm long, appressed-pubescent outside and usually glabrous inside; small follicles opening as soon as mature to release the obovate seeds.

Three varieties are formally recognised in this paper. The var. *integrifolia* is fairly constant over most of its range but in northern N.S.W. and south eastern Qld there are populations intermediate in morphology between it and var. *compar*. The latter is ex-

tremely variable, as might be expected from its widely differing habitats. The northern variety, var. *aquilonia*, is geographically disjunct, easily recognised by its scattered, narrow leaves, and is relatively constant.

Near Townsville there is another variant but as yet it is insufficiently known to be formally named. There are two early collections from the Coast Range, Rockingham Bay, gathered on 20 December 1867 and 21 February 1868 by John Dallachy (both collections represented at K and MEL). On 28 August 1979 a collection was made by F. D. Hockings on the upper slopes of Hinchinbrook Island (BRI 251630). The plant is a shrub, with obtusely serrate to almost entire mature leaves that are densely ferruginous-tomentose when young. The flowers were described by Dallachy as "pale blue" and by Hockings as "greenish-purple". Young fruit with the Hockings collection have follicles that are somewhat obliquely angled along the upper part of the ridge, but a large sample is needed to determine whether this is a consistent feature.

The closest relatives of *B. integrifolia* are *B. dentata* L.f. and *B. marginata* Cav. *B. dentata* is distinguished from *integrifolia* by its scattered, broad, very undulate, dentate mature leaves of relatively thin texture, and by its flowers of coarser aspect due to the broader perianth claws and thicker styles; the follicles are usually larger. The two species have separate geographical ranges except for a small area of overlap south of Cooktown, north Queensland, but in this area they apparently are not sympatric. *Banksia marginata* is distinguished by its smaller leaves, flowers and fruits, and by the styles being also very slender; this species may be either frutescent or arborescent.

Two taxa previously regarded as variants of *B. integrifolia* are described below as new species, viz *B. saxicola* George from The Grampians and Wilsons Promontory in Victoria, and *B. conferta* George with two varieties, one from the Glasshouse Mountains and the Lamington Plateau in Queensland, the other from the Blue Mountains north west of Sydney.

2A. Banksia integrifolia L.f. var. **integrifolia** (Figure 19E and F)

B. integrifolia L. f. var. *typica* Domin, Bibl. Bot. 1:598 (1921). Nom. illeg.=*B. integrifolia* var. *integrifolia*.
B. oleaefolia Cav., Anal. Hist. Nat. 1:228 (March 1800), non Salisb. *Type citation:* "Se cria en las cercanias de Jackson". Lecto (here chosen): MA (photo seen) labelled "Prope oppidum Jackson in Nova Hollandia. Née dedit" (in Cavanilles' hand).
B. spicata Gaertner, De Fruct. Sem. Pl. 1:221, tab. 48 fig. 2. *Type citation:* none given. Neo (here nominated): TUB, a single loose infructescence labelled "Banksia spicata" in two different hands, neither of which appears to be that of Gaertner. The specimen is similar to the plate.
B. glauca Cav., Anal. Hist. Nat. 1:230 (Mar. 1800). *Type citation:* "Se cria en las cercanias de Bahia-botanica junto a la Hakea piriformis". Lecto (here chosen): MA (photo seen). Collected by Luis Née in 1793.
B. integrifolia L. f. var. *major* R.Br. ex Meissner in DC. Prod. 14:457 (Oct. 1856). *Type citation:* "In ora australi circa Port-Phillip. (R.Br.)". Lecto (here chosen): K. The sheet bears one flowering specimen, one in bud and one with juvenile leaves. Iso: BM—a sheet labelled by Brown "14 Banksia integrifolia prodr. 395 Port Phillip Bay 1802". This sheet bears two leafy specimens and a separate inflorescence.
B. integrifolia L. f. var. *minor* R. Br. ex Meissner in DC. Prodr. 14:457 (Oct. 1856). Nom. illeg. based on *B. integrifolia* L. f.

Juvenile leaves cuneate, 3–6 cm long, 2–3 cm wide. *Mature leaves* whorled, narrowly obovate to narrowly elliptic, obtuse or emarginate, 4–10 cm long, ± flat, usually dull dark green above. *Common bracts* obtuse. *Perianth* 22–25 mm long. *Pistil* 27–32 mm long; ovary hirsute around apex.

Distribution. (Fig. 21) South eastern and eastern Australia; a coastal taxon extending from the eastern side of Port Phillip Bay, Victoria, to Wide Bay and Fraser Island, Queensland; also recorded on King and Long Islands, Bass Strait.

Selected collections. QUEENSLAND: Cooloola, near Freshwater Ck, 3 Oct. 1971, *A. G. Harrold* (BRI); Tugun, 66 miles (110 km) SE of Brisbane, 5 July 1930, *C. E. Hubbard* 3947 (BRI, K, S); Point Lookout, Stradbroke Island, 20 April 1953, *D. A. Goy* (BRI).
NEW SOUTH WALES: Byron Bay, 28 April 1975, *A. S. George* 13012 (CANB, PERTH); 12 miles (20 km) E by S of Singleton, 9 May 1960, *R. Story* 7379 (CANB, MEL); Narrabeen, 7 June 1948, *R. A. Oxenford* (NSW); 2 miles (3·2 km) SE of Womboyn, 24 miles (39 km) NNE of Timbillica by road, *R. Coveny* 2943 (MEL, NSW, PERTH).
VICTORIA: Sealers Cove (Wilsons Promontory), 1854, *F. Mueller* (MEL); near Mt. Dromedary, 18 March 1880, *F. M. Reader* (MEL).
TASMANIA: King Island, 1876, *E. N. Spong* (MEL).

Habitat. Typically on consolidated sand dunes close to the coast and along tidal inlets, as a component of woodland and low woodland.

Flowering period. Mainly January to June.

Banksia integrifolia var. *integrifolia* is a common coastal plant of consolidated dunes, occasionally occurring a short way inland along inlets and estuaries. It is characterised especially by the short, usually obtuse and dull green leaves, and to a minor extent by the small differences from var. *compar* given in the above diagnosis. The trees are often massive, having been recorded as tall as 25 m. Root suckers are sometimes produced if the roots are uncovered or disturbed.

Presumed natural hybrids with *B. marginata* Cav. occur on Wilsons Promontory, Victoria, where both species grow together in several localities. The hybrids are morphologically intermediate between the parents.

The occurrence reported at the Lower Glenelg River, Victoria (e.g. Willis, 1972) is now considered an error (A. Salkin, pers. comm.). That from King Island may also be incorrect (P. Barnett, King Is., pers. comm.).

2B. Banksia integrifolia L.f. var. **compar** (R.Br.) Bailey (Figure 19C and D).

Comp. Cat. Queensl. Pl. 455 (1913), based on *B. compar* R.Br., Trans. Linn. Soc. London 10:207 (Feb. 1810).

Type citation: "In Novae Hollandiae orâ orientali; propc Keppel Bay: juxta littora. (ubi v.v. absque fructu.)". Holo: a sheet at BM labelled by Brown "Port 1 East Coast ob: s . . . s" and on the reverse side "15. Banksia compar prodr. 393". Port I is between Curtis and Facing Islands, just south of Keppel Bay.

Juvenile leaves narrowly obovate, (6)10–18 cm long, 1–2(3) cm wide. *Mature leaves* whorled, narrowly obovate to narrowly elliptic (5)10–20(23) cm long, undulate, usually shining dark green above. *Common bracts* obtuse. *Perianth* 22–25 mm long. *Pistil* 31–33 mm long; ovary silky in upper half.

Distribution. (Fig. 21) Eastern Australia: on the Great Dividing Range in New South Wales from Mt. Wilson northwards, continuing into Queensland where from Wide Bay to Proserpine it occurs on or near the coast. In northern N.S.W., intermediates between var. *compar* and var. *integrifolia* occur mainly between the mountains and the coast.

Selected collections. QUEENSLAND: South Percy Island, 5 March 1906, *H. Tryon* (BRI); S.F.R. 652, Cawley, 7 May 1975, *B. Hyland* 8181 (QRS); Wide Bay District near Bundaberg, 26 April 1936, *S. T. Blake* 11301 (BRI); Tugun, SE Qld, 7 Sept. 1930, *C. T. White* 7135 (BRI); Mt. Tibrogargon, 23 July 1972, *F. D. Hockings* (BRI); Just S of Coomera R., Canungra-Beechmont Road, 26 April 1975, *A. S. George* 13005 (PERTH, BRI).

NEW SOUTH WALES: Upper Manning River, 19 miles (31 km) SSW of Curricabark on Tomalla-Upper Bowman Road, 23 Sept. 1968, *D. Blaxell* and *R. Coveny* 584 (NSW); Summit, Point Lookout, 5 200 ft., (SE of Ebar), 2 Nov. 1951, *L. A. S. Johnson* (NSW); Happy Valley, Mt. Wilson, alt. 3 150 ft, 21 Dec. 1948, *E. F. Constable* (NSW).

Habitat. Occurs in a wide range of habitats from coastal dunes (at the northern end of its range) to montane forest (in New South Wales); in northern N.S.W. and southern Qld often in sand or loam in sclerophyllous woodland or open-forest. The soil is often basaltic, especially in montane habitats. Sometimes in seasonal swamps.

Flowering period. Mainly January to June, but flowers may be produced at other seasons.

The var. *compar* in its typical, northern form is easily distinguished from the other varieties by its large, undulate leaves that are shining above. In some areas, e.g. Rainbow Beach and Bribie Island, it occurs close to but never sympatric with the var. *integrifolia*. Only at Keppel Bay and farther north is it littoral; to the south the var. *integrifolia* is always littoral, and the var. *compar* occurs farther inland and on the hills. Some populations in northern N.S.W. and south eastern Qld. are intermediate between the two. George 13005, 13020 and 13033 have obtuse, undulate leaves 7–12 cm long, i.e. intermediate in size. George 13028 has narrowly cuneate juvenile leaves, and narrowly obovate to narrowly cuneate mature leaves 6–12 cm long and 2–3 cm wide.

The montane forms between Lamington Plateau and Mt. Wilson have narrowly elliptic leaves, not or slightly undulate, but not as narrow as those of the var. *aquilonia*, from which they are at once distinguished by the whorled arrangement. They are not

typical of var. *compar* but I think are better placed with it rather than with var. *integrifolia* Another alternative would be to describe them as another variety, but there is no adequate character by which it could be satisfactorily distinguished from var. *compar*.

Although always arborescent, var. *compar* does not reach the massive size of var. *integrifolia*. Typical plants in Queensland reach about 10 m and are usually irregular in the trunk and crown. Those in the montane forests of New South Wales are often straight-trunked and may reach 16 m.

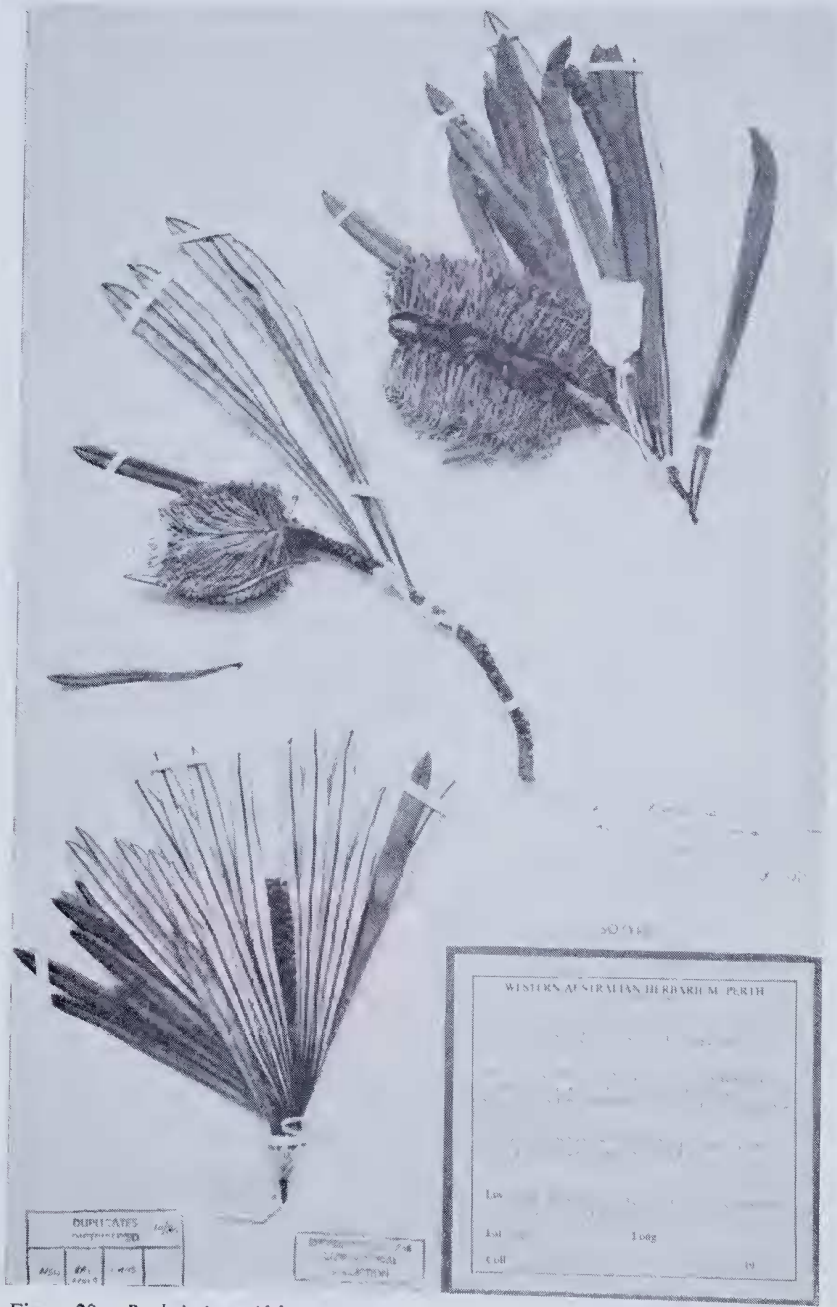


Figure 20. *Banksia integrifolia* var. *aquilonia*. Isotype, A. S. George 12973 (PERTH).

2C. Banksia integrifolia L.f. var. **aquilonia** A. S. George, var. nov. (Figures 19A and B, 20)

Folia juvenilia angustissime obovata ad lanceolata, acuta, 7-24 cm longa, 6-21 mm lata, saepe dentata. *Folia adulta* sparsa (raro verticillata), angustissime obovata ad lanceolata, acuta, 5-20 cm longa, 6-12 mm lata, supra atro-viridia nitentia; infra in utroque costae pilis rigidis ferrugineis pubescentia. *Bracteae communes* acutae. *Perianthium* 25-29 mm longum. *Pistillum* 30-34 mm longum; ovarium in dimidio supero appresso-papillosum.

Type: Witts Lookout No. 1, Crystal Creek National Park, S of Ingham, Queensland, 12 April 1975, *A. S. George* 12973. Holo: BRI; iso: CANB, NSW, PERTH.

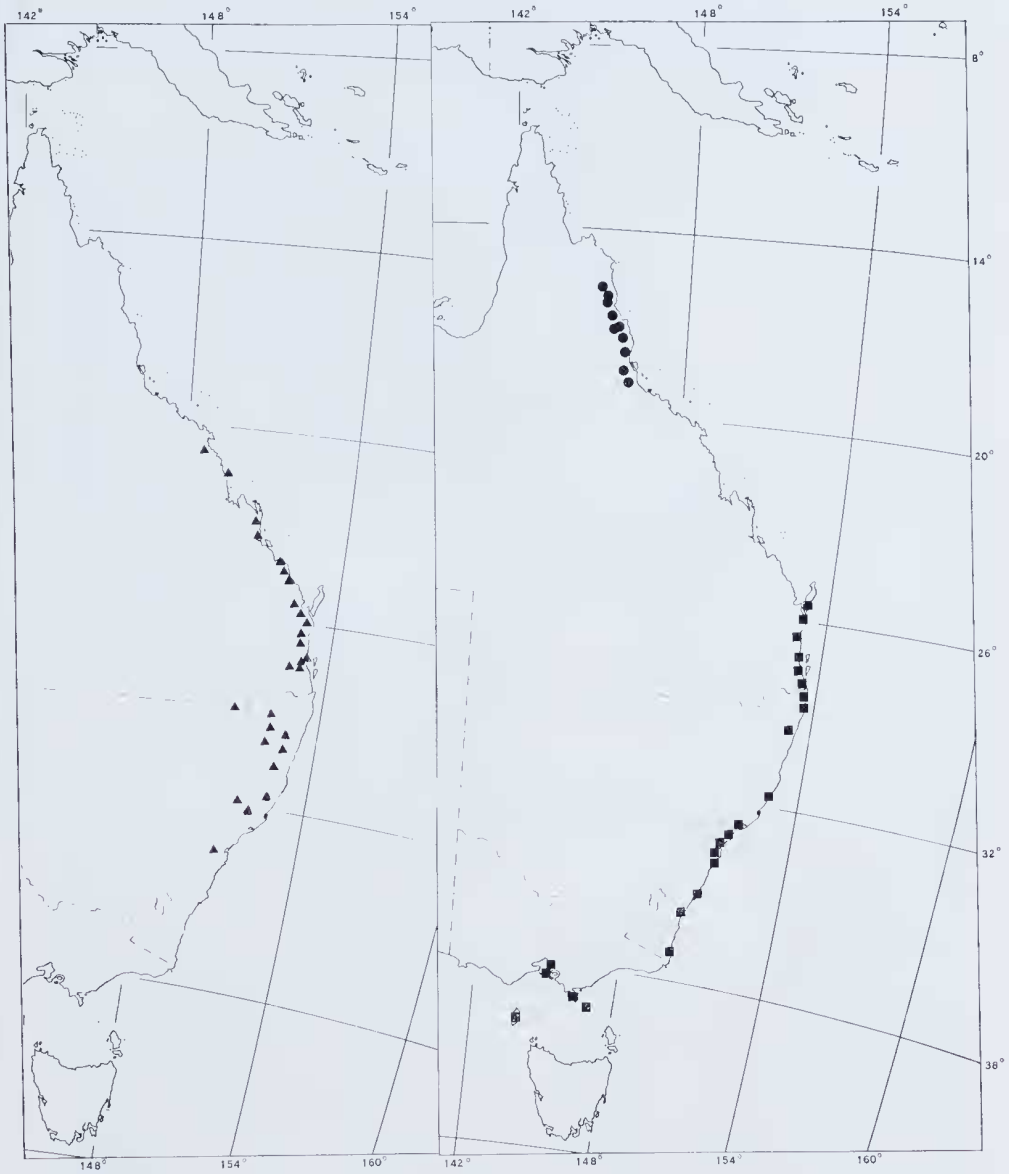


Figure 21. Distribution of *Banksia integrifolia* var. *integrifolia* (■), *B. integrifolia* var. *aquilonia* (●) and *B. integrifolia* var. *compar* (▲).

Juvenile leaves very narrowly obovate to lanceolate, acute, 7–24 cm long, 6–21 mm wide, often dentate. *Mature leaves* scattered (rarely whorled), very narrowly obovate to lanceolate, acute, 5–20 cm long, 6–12 mm wide, shining dark green above; ± rigid ferruginous hairs persistent on both sides of midrib below. *Common bracts* acute. *Perianth* 25–29 mm long. *Pistil* 30–34 mm long; ovary appressed-papillose in upper half.

Derivation of name. From the Latin *aquilonius*, northern, in reference to the geographical range relative to the other varieties of the species.

Distribution. (Fig. 21) North Queensland; coastal and montane areas from Mt. Finnigan National Park to the Paluma Range.

Selected collections. T.R. 146, Tableland L.A., in 15°45'S, 145 15'E, 9 July 1975, *B. Hyland* 8331 (QRS); Foothills of Thornton Peak, 13 March 1932, *L. J. Brass* 2328 (BRI); Mt. Bellenden Ker, 1891–93, *G. Podenzana* s.n. (BM); Wallum Peak, W of Atherton, 14 April 1975, *A. S. George* 12978 (BRI, PERTH); 26 km N of Cardwell, Bruce Hwy, 16 April 1975, *A. S. George* 12981 (PERTH); ± 6 miles (10 km) west of Paluma, Coane Ra., 27 July 1975, *B. Jackes* (JCT).

Habitat. In sand, usually granitic, on hillsides, ridges, creek banks or flats, sometimes poorly drained, in woodland, open-forest, or the edge of rainforest, sometimes (on exposed ridges) in open scrub.

Flowering period. March to June.

This variety can usually be distinguished by its narrow, acute leaves which are scattered, not whorled. Other differences are given in the diagnosis above. The rigid, short, ferruginous hairs along each side of the midrib on the lower surface do not occur in any other species. Although characteristic of var. *aquilonia* they sometimes wear off completely from old leaves. In the scattered leaves the variety approaches *B. dentata* L.f. but the general aspect is quite that of *integrifolia*. The trees are often large, up to 15 m tall, but not as massive as those of var. *integrifolia*.

At the northern end of its range, var. *aquilonia* overlaps the distribution of *B. dentata* but as far as I am aware the two are never sympatric.

When Bailey published the combination *B. integrifolia* var. *compar* he apparently misapplied the name to this northern taxon, for his illustration (tab. 443) appears to represent it.

3. Banksia conferta A. S. George, sp. nov. (Figure 22)

Frutex ad 4 m alta sine (? vel cum) lignotubero. *Folia adulta* verticillata, elliptica vel obovata, 3.5-12 cm longa, 7-40 mm lata, marginibus recurvis undulatis, integris vel serratis; lamina supra hirsuta deinde glabra, infra in venis hirsuta pilis ferrugineis tandem glabra, interstitiis albo-tomentosis. *Inflorescentia* cylindrica, 5-6 cm diam. *Floribus* confertis luteis. *Axis* 7-19 cm longus. *Bracteae involucrales* ad 2cm longae, tomentosae vel villosae. *Bracteae communes* 3·5-5 mm longae apicibus exsertis conicis sursum versis pubescentibus vel penicillatis. *Perianthium* 20-25 mm longum limbo 3-4 mm includens, unguibus gracilibus extus pubescentibus intus + glabris; limbus pubescens. *Pistillus* gracilis 22-26 mm longus, glaber; pollinis praebitor angustus, 0·7-1 mm longus. *Infructescentia* cum perianthiis stylibusque persistentibus. *Follicuti* multi, anguste-elliptici, 8-15 mm longi, 2-6 mm alti, 3-5 mm lati, valvis convexis hirsutis deinde + glabris. *Semina* obovata, 14-17 mm longa; seminis corpus ± lunatum, 8-9 mm latum.

Type: Upper W slope of Mt. Tibrogargon, Glasshouse Mts, Queensland, 25 April 1975, *A. S. George* 13000. Holo: BRI; iso: CANB, K, MEL, NSW, PERTH.

Derivation of name. From the Latin *confertus*, crowded, in reference to the closely set flowers.

Cotyledons (Fig. 8.3) broadly obovate, emarginate, sometimes with unequal lobes, 7–10 mm long, 5–7 mm wide, spreading, full or medium green sometimes with a fine red margin, ± 3-nerved in lower half, reticulate above; auricles ± horizontal, acute, 1·5–2 mm long. *Hypocotyl* slender, 15 mm long, dark green, appressed-hirsute. *Seedling leaves:* first 2 usually opposite, close above cotyledons, broadly linear to narrowly obovate, obtuse, 5–15 mm long, margins slightly recurved, dentate towards apices with 1–3 teeth each side, the teeth triangular, mucronate, ± 1 mm long; upper surface hirsute becoming

Figure 22. *Banksia conferta.* A, B and C—*B. conferta* var. *conferta* A—Habit, ± 2·5 m tall. B—Bark. C—Inflorescence in late bud; whorled, undulate leaves. (Mt. Tibrogargon, Qld.). D and E—*B. conferta* var. *penicillata* D—Habit, ± 3·5 m tall. E—Branches with old inflorescences and developing buds; (Newnes—Clarence Road, N.S.W.).

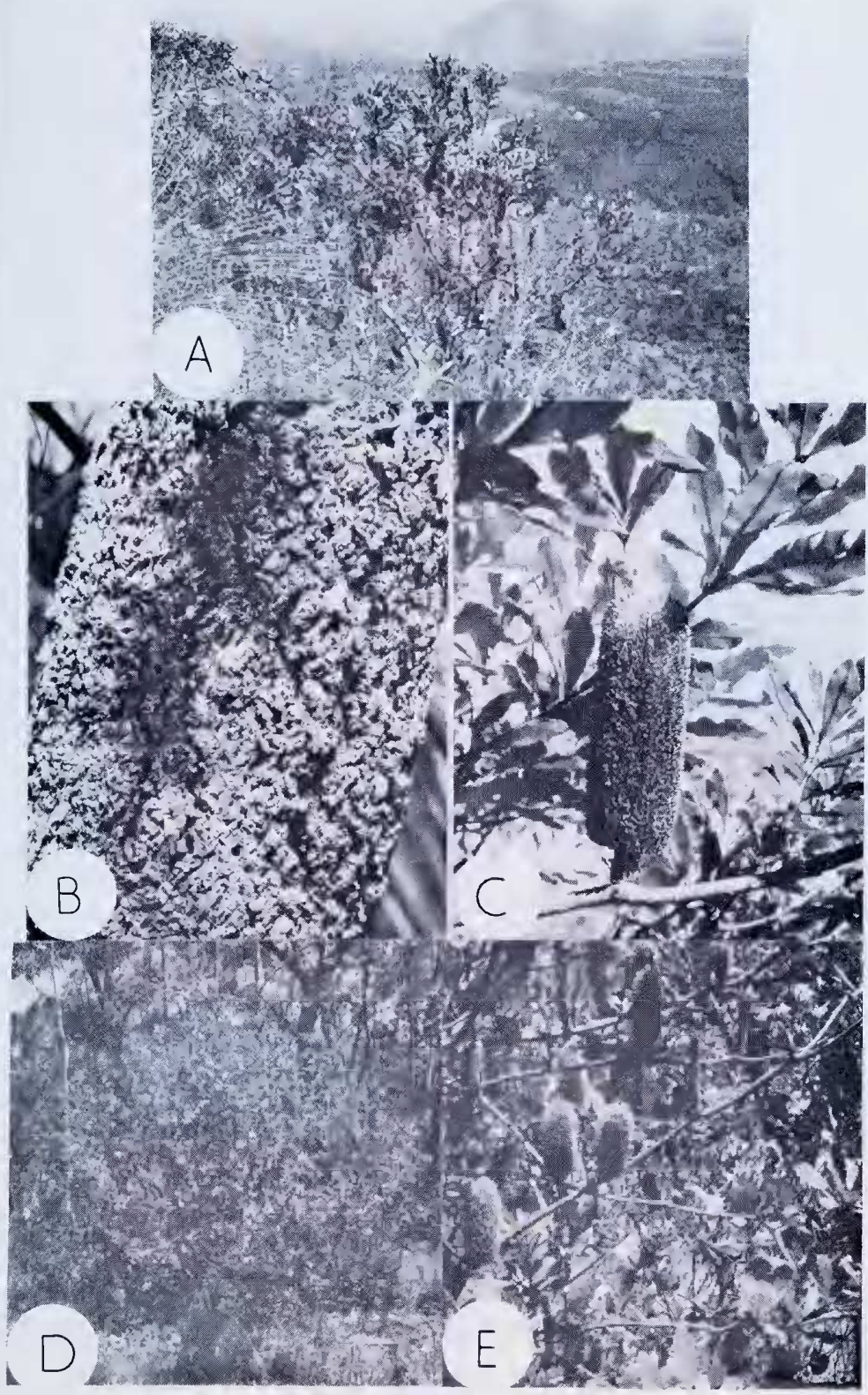


Figure 22.

glabrous, lower surface white-tomentose; lateral nerves obscure; upper leaves progressively larger, obovate but tapering to base, obtuse to truncate, mucronate, up to 12 cm long and 4 cm wide, serrate, the teeth mucronate, up to 3 mm long; sinuses obliquely U- to V-shaped; indumentum as in first leaves; petiole 2–7 mm long. *Seedling stem* hirsute and pubescent with long straight and short curled hairs, becoming glabrous, often orange-red.

Mature plant a shrub to 4 m, ? with lignotuber in var. *conferta*, without lignotuber in var. *penicillata*, openly branched; trunk up to 15 cm diam. at base. *Bark* at first smooth with small lenticels, in var. *conferta* becoming roughly tessellated and grey, in var. *penicillata* remaining ± smooth. *Branchlets* slightly striate, villous when young with ferruginous long and short hairs, becoming pubescent then glabrous, orange, red or brown, finally grey. *Leaves* whorled, elliptic to obovate, obtuse, often mucronate with an obtuse hirsute mucro, 3·5–12 cm long, 7–40 mm wide, narrowed quickly to a petiole 5–10 mm long; margins entire or serrate, recurved, somewhat undulate, the teeth mucronate and up to 3 mm long; upper surface sparsely hirsute with long straight hairs and pubescent with very short curled hairs, becoming glabrous, dull; lower surface with midrib and lateral nerves hirsute with long and short ferruginous hairs, persistent for some time on midrib but eventually all glabrous, lacunae white-tomentose; lateral nerves at 60–80° to midrib, reticulate between; petiole hirsute becoming glabrous. *Inflorescence* cylindrical, 5–6 cm diam. at anthesis, at apex of a 2–4 year old branchlet, often with whorl of lateral branchlets below, sometimes at successive nodes in one season. *Axis* 7–19 cm long, 3·5–6 mm wide, 12–16 mm wide with common bracts, without flowers for 1–2 cm at base. *Involucral bracts:* outer bracts triangular, 2–5 mm long, tomentose, grey-brown, grading to inner bracts which are subulate from thick bases, 10–20 mm long, densely tomentose or villous, ferruginous, persistent. *Common bracts* narrowly oblong, 3·5–4 mm long, densely hirsute; exserted apex conical, upturned, tomentose, brown, the extreme apex closely pubescent and pale in var. *conferta*, penicillate and brown in var. *penicillata*. *Floral bracts* shorter, narrower, without prominent apices. *Flowers* crowded; buds yellowish green becoming pinkish brown with grey limbs (in var. *conferta*), bluish-grey (in var. *penicillata*); flowers golden to pale yellow. *Perianth* 20–25 mm long, including limb of 3–4 mm, straight with limb upturned before anthesis; claws filiform, 0·2–0·4 mm wide, shortly appressed-pubescent outside, glabrous inside except for a few hairs in upper part; limb fusiform to narrowly elliptic, ± obtuse, appressed-pubescent; perianth relaxed after anthesis, leaving styles projecting 5–7 mm. *Anthers* ± 1 mm long, shortly apiculate; filament almost 1 mm long. *Hypogynous scales* narrowly triangular to oblong, obtuse, 1–1·5 mm long, free. *Pistil* slender, 22–26 mm long, curved slightly down then up, glabrous; pollen-presenter scarcely thickened, smooth, 0·7–1 mm long, dark with pale apex; stigmatic groove oblique; ovary hirsute around apex with ferruginous straight hairs, otherwise glabrous. *Infructescence* moderately robust, 4–4·5 cm diam., the old inflorescence bracts, perianths and styles persistent for several years; common and floral bracts indurated, the apices pale grey. *Follicles* numerous, often over 100, usually remaining closed until burnt, but some opening spontaneously; in plan view narrowly elliptic, 8–15 mm long, 2–6 mm high, 3–5 mm wide; valves semi-elliptic, convex, smooth, hirsute and tomentose becoming glabrous on exposed parts, dark brown or grey; ridge narrow, slightly undulate; suture impressed; follicles opening to 5–9 mm wide, not or slightly recurved; lips ± 1 mm wide. *Seed* obovate, 14–17 mm long; seed body shallowly lunate, obtuse at base, 8–9 mm long, 2–3·5 mm wide, stylar margin ± straight, both margins narrowly bordered; inner surface convex, smooth or very slightly rugose, black or dark brown, glistening; outer surface flat or slightly convex, slightly rugose, black-brown, ± glistening; wing 6–7 mm wide, rounded or flattened across apex, with a shallow beak to stylar point, the anti-stylar side decurrent half-way down seed body; dark brown. *Separator* similar to seed in shape and size; wings slightly recurved.

Banksia conferta is a species of restricted distribution with two varieties found in areas some 600 km apart. The typical variety is restricted to the Glasshouse Mountains near Brisbane and the Lamington Plateau and was first collected in 1951. The other, described below as var. *penicillata*, occurs in small populations in the Blue Mountains north west of Sydney. A collection was made in 1906, but only in the past 20 years have further gatherings been made.

Characteristics of the species are its shrubby habit, whorled elliptic or obovate adult leaves that are entire or serrate, ferruginous indumentum on new growth; inflorescences up to 19 cm long with fine crowded flowers that are pinkish-brown and grey in bud, opening yellow; involucral bracts up to 2 cm long; slender, appressed-pubescent perianths 20–25 mm long; slender pistils 22–26 mm long with narrow pollen-presenters; infructescences with old flowers persistent; and rather small follicles that usually remain closed until burnt.

The species is probably derived from *B. integrifolia* and has diverged sufficiently to become specifically distinct. It differs especially in the crowded, differently coloured flowers and in the infructescences with persistent old flowers and closed follicles. There is, in the var. *penicillata*, a resemblance to *B. paludosa*, but the latter may be distinguished by its lignotuber, more sparse indumentum, slender inflorescences with openly arranged flowers and short perianths.

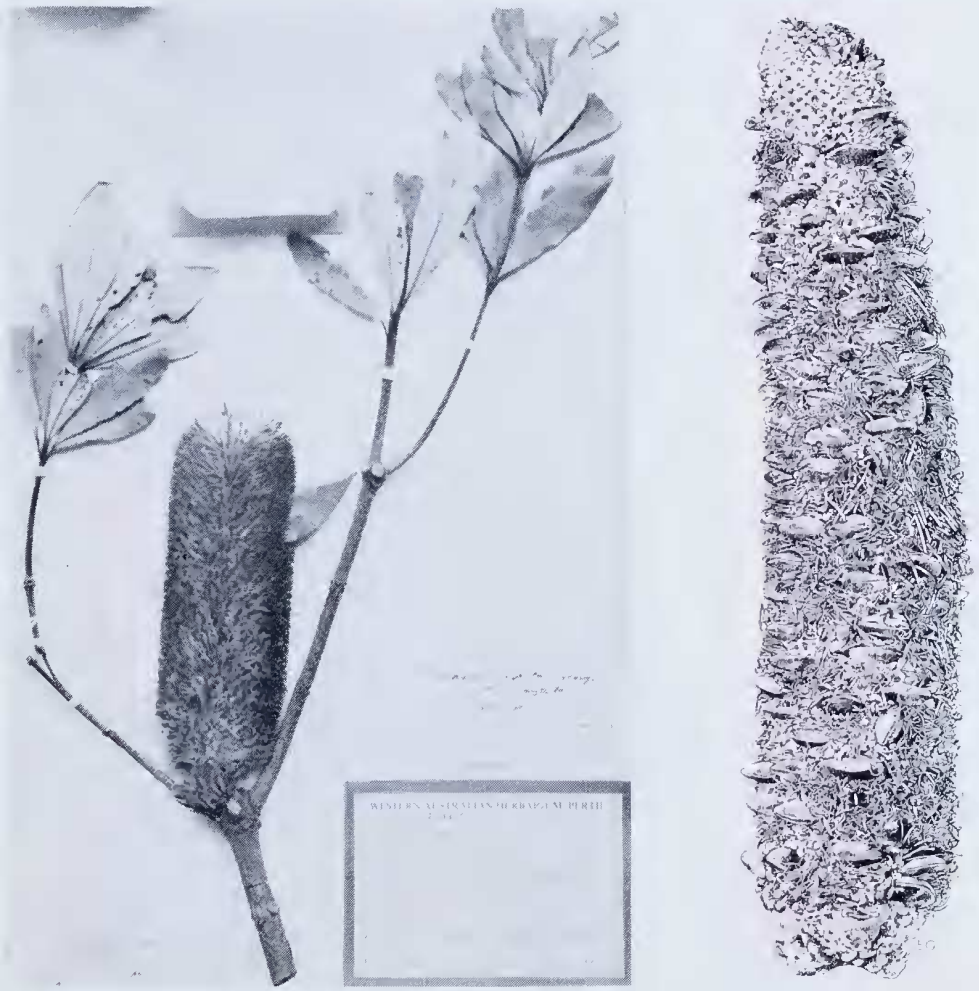


Figure 23. *Banksia conferta* var. *conferta*. Left—Isotype, A. S. George 13000 (PERTH). Right—Infructescence—$\frac{3}{4}$ natural size (A. S. George 12998).

3A. Banksia conferta A. S. George var. **conferta** (Figures 22A–C, 23)

Bark tessellated. *Mature leaves* entire. *Involucral bracts* densely pubescent. *Common bracts* with the exserted apices closely pubescent, pale. *Follicles* mostly 8–12 mm long.

Distribution. (Fig. 27) Queensland, where endemic to the Glasshouse Mountains and the Lamington Plateau.

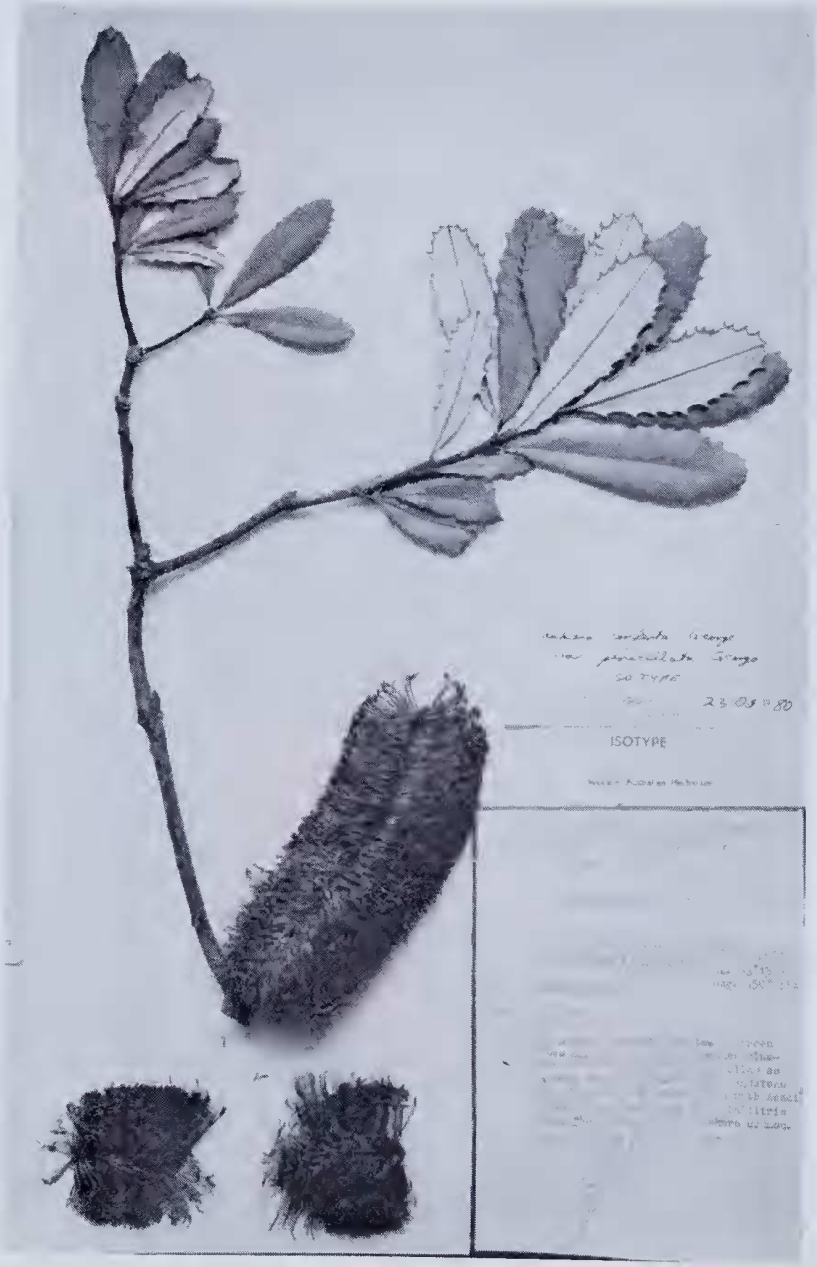


Figure 24. *Banksia conferta* var. *penicillata*. Isotype, R. Coveny 3537 (PERTH).

Selected collections. Mt. Beerwah, 23 April 1972, *F. D. Hockings* (BRI); Mt. Tibrogargon, 16 June 1974, *J. Birbeck* (BRI); Lamington National Park MacPherson Ra., 2 700 ft., 20 May 1951, *L. A. S. Johnson* s.n. (NSW); Daves Creek Country, Lamington National Park, 27 April 1975, *A. S. George* 13009 (BRI, PERTH); Mt. Barney, near summit, June 1972, *C. Bell* 532 (BRI).

Habitat. On steep, rocky (granite or sandstone) slopes, in tall open-shrubland and open scrub.

Flowering period. Late April to July.

This variety is distinguished especially by the entire leaves, the pubescent involucral bracts and the closely pubescent pale apices of the common bracts. The follicles seem consistently smaller than in var. *penicillata*. Although I have no data on their response to fire, the plants appear likely to be fire-resistant; the tessellated bark is 5–7 mm thick, in contrast to the thin bark of fire-sensitive shrubby taxa of the genus.

The populations on the Lamington Plateau differ from those on the Glasshouse Mountains in having thicker branchlets that remain villous longer; less prominent lateral nerves on the underside of the leaves; shorter inflorescences, mostly 5–12 cm long; slightly longer indumentum on the apices of the common bracts; flowers of a deeper yellow; and follicles that sometimes open when mature.

3B. Banksia conferta A. S. George var. **penicillata** A. S. George, var. nov. (Figures 22D and E, 24)

Cortex laevis cum lenticellis. *Folia adulta* serrata. *Bracteae involucrales* dense villosae. *Bracteae communes* cum apicibus exsertis penicillatis, ferrugineis. *Folliculi* plerumque 11-15 cm longi.

Type: N of Clarence on the Newnes tunnel road, New South Wales, 6 April 1971, *R. Coveny* 3537. Holo: NSW; iso: PERTH.

Derivation of name. From the Latin *penicillatus*, tufted, in reference to the tuft of long hairs on the apex of the common bracts.

Bark ± smooth with lenticels. *Mature leaves* serrate. *Involucral bracts* densely villous. *Common bracts* with the exserted apices penicillate, brown. *Follicles* mostly 11–15 mm long.

Distribution. (Fig. 27) New South Wales, where restricted to a few localities in the Blue Mountains north west of Sydney.

Selected collections. Walgan River, alt. 3 000 ft, 15 Aug. 1906, *R. H. Cambage* 1546 (NSW); Baal Bone Gap via Cullen Bullen, 17 May 1970, *P. Hitchcock* (NSW); Just S of tunnel, Clarence-Newnes Road, in 33°15′S, 150 13′E, 3 Nov. 1979, *A. S. George* 15792 (NSW, PERTH).

Habitat. In rocky (sandstone) situations, at the top and base of cliffs or steep slopes and around outcrops, in sclerophyllous open forest or woodland with *Eucalyptus*, *Syncarpia*, *Angophora*, *Leptospermum*, etc. Occasionally in shaly loam in sclerophyllous forest, but then in semi-disturbed locations.

Flowering period. March to June.

This plant has been referred to *B. palmdosa* R.Br. but its affinity is clearly with *B. conferta*. It differs from the typical variety of the latter essentially in the characters given in the diagnosis, which do not warrant specific rank. The plants are non-lignotuberous; those of var. *conferta* appear to have lignotubers but further study is needed to confirm this. The reticulate leaf venation of var. *penicillata* is less conspicuous than that of var. *conferta*.

A group of plants presumed to be natural hybrids between var. *penicillata* and *B. marginata* Cav. was recorded near the Clarence-Newnes Road. The site was on an abandoned railway line on a disused mining site, which has long since reverted to almost natural *Eucalyptus* forest. Several plants of typical var. *penicillata* were present, together with a single *marginata*. The hybrids were morphologically intermediate but with *penicillata* characters dominant as seen in the dentate leaves, and flowers and fruit more like those of *penicillata*. Collections are represented by A. S. George 15785–15789 (hybrids), 15790 (var. *penicillata*) and 15791 (*B. marginata*), lodged at NSW and PERTH.

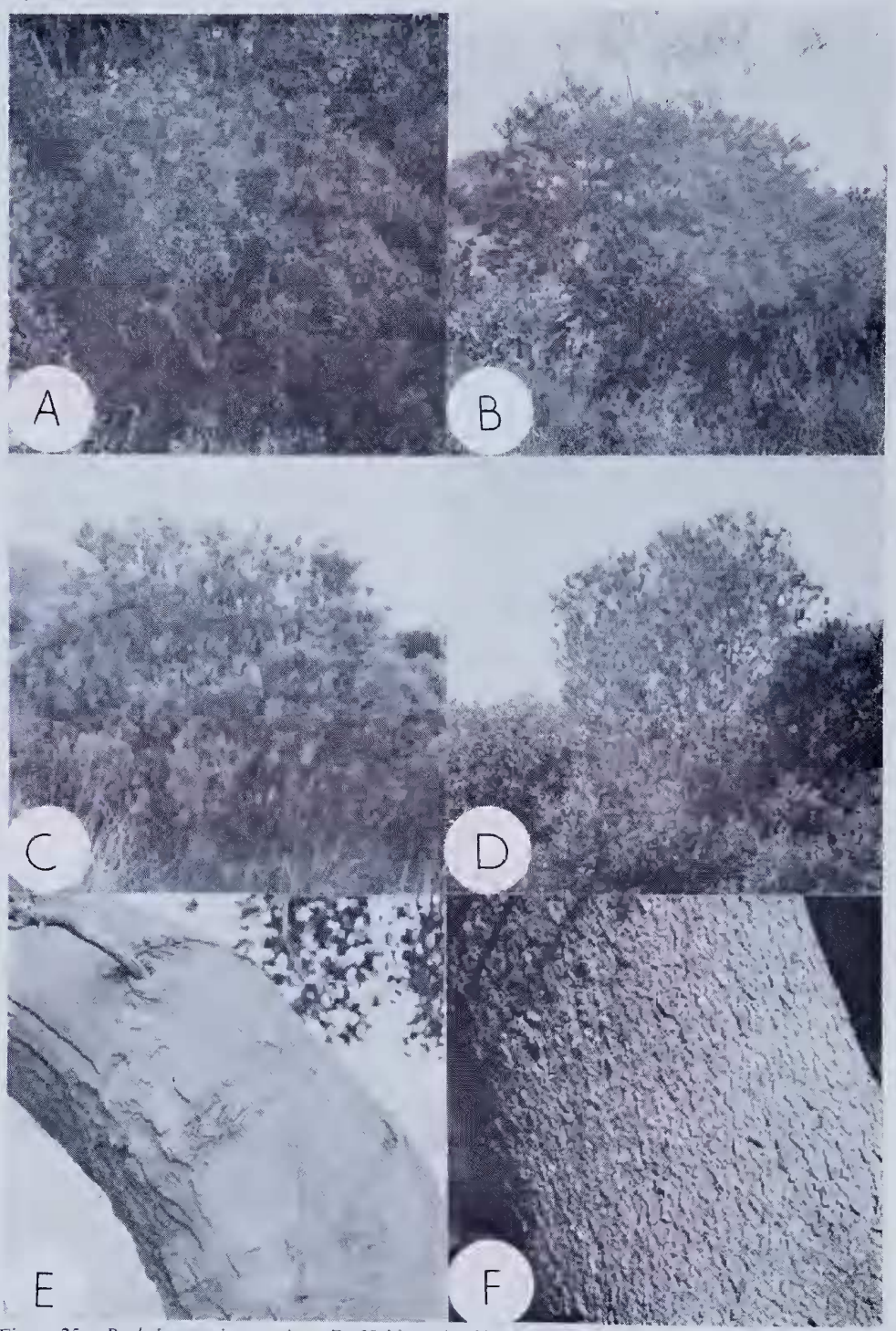


Figure 25. *Banksia marginata*. A to D: Habit. A—Shrub ± 80 cm tall; Marble Ra., S.A. B—Shrub ± 2 m tall; Heathcote Rd., S of Sydney, N.S.W. C—Shrub 2·5 m tall; S of Bathurst Harbour, Tas. D—Tree ± 7 m tall; (WNW of Portland, Vic.). E and F: Bark of arborescent plants. (E—NW of Campbell Town, Tas. F—WNW of Portland, Vic.).

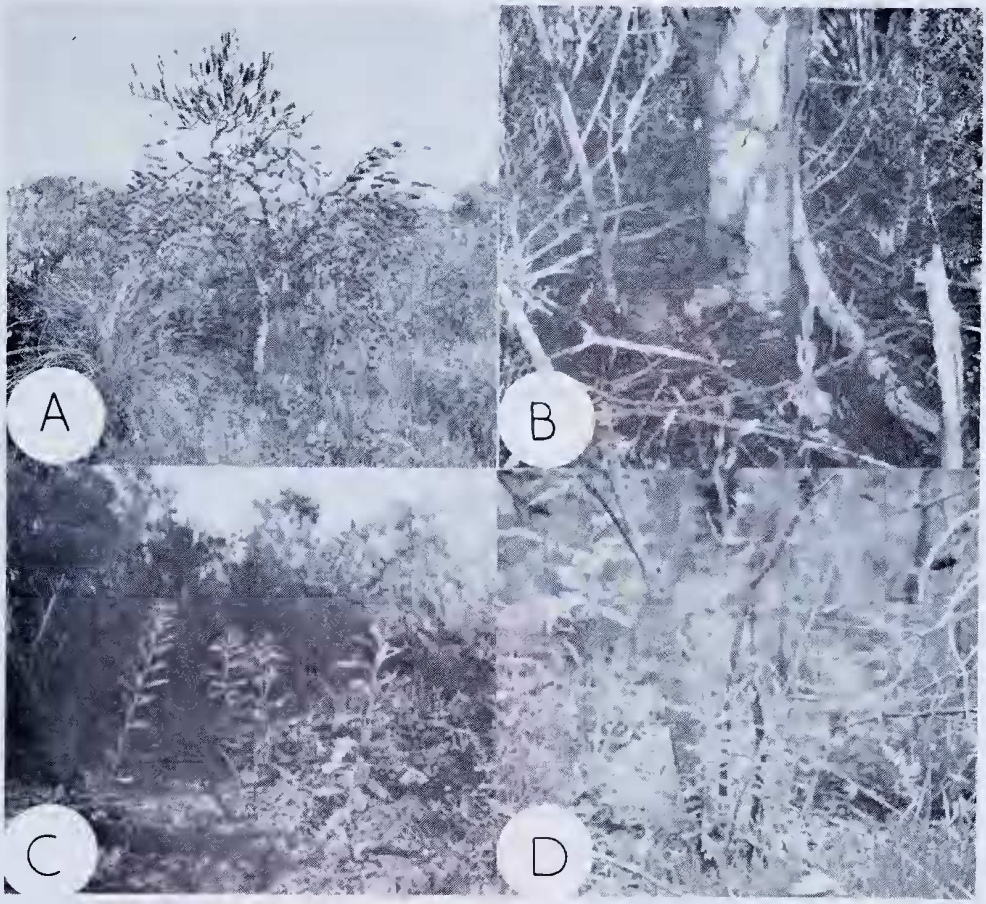


Figure 26. *Banksia marginata*. A—Plant killed by fire—note prolific old fruit (Heathcote Rd., S of Sydney, N.S.W.). B—Base of plant killed by fire (SW of Roseberry, Tas.). C—Suckers from roots of shrubby variant (Cape Nelson, Vic.). D—Regrowth from lignotuber after fire (Chimneypot Hill, Hobart, Tas.).

4. Banksia marginata Cav. (Figures 25 and 26)

Anal. Hist. Nat. 1:227 (March 1800).

Type citation: "Crece caminando de Jackson a Paramatta, donde la hallo en flor y en fruto el citado Née. Creo que el fruto era del ano anterior". Lecto (here chosen): MA (photo seen).

B. australis R.Br., Trans. Linn. Soc. London 10:205 (Feb. 1810). *Type citation:* "In Insula Diemen, ubique in campis et prope littora, necnon in orâ australi Novae Hollandiae prope Port Phillip. (ubi v.v.)". Lecto (here chosen): a sheet at BM labelled by Brown "12 Banksia marginata var. (sic) australis prodr. 393 Port Dalrymple Jan. 1804". A possible syntype at BM is labelled by Brown "Banksia australis prodr. Port Philip 1802?" with "Van Diemen's Island 1804" crossed out.

B. depressa R.Br., Trans. Linn. Soc. Lond. 10:205 (Feb. 1810)—*B. australis* R.Br. var. *depressa* (R.Br.) J. D. Hooker, Fl. Tas.: 329 (Dec. 1857). *Type citation:* "In Insulae Diemen plagis australioribus; in saxosis ad radices montium. (ubi v.v.)". Lecto (here chosen): BM, labelled by Brown "10 Banksia depressa prodr. 393. Van Diemen's Island Stony ground near the Banks of Anna Maria's River".

B. depressa R.Br. var. *subintegra* Meissner in DC. Prodr. 14:456 (Oct. 1856)—cited in name only in Hook. Journ. (1852) 210. *Type citation:* "In monte Wellington, ins. Diemen (Gunn, n. 1234!). ... v.s. comm. a cl. Lindl." Two syntype sheets are at K and one at BM; from these the lectotype here selected is the top left-hand specimen on the sheet at BM. The sheet is labelled "1234/1842 Mt. Wellington 8/5/39". Similar labels are on the two sheets at K.

B. ferrea Vent. ex Sprengel, Syst. 1:485 (1825). Nomen nudum, cited in synonymy under *B. marginata* Cav.

B. gunnii Meissner in DC. Prodr. 14:456 (Oct. 1856)—cited in name only in Hook. Journ. 4:210 (1852). *Type citation:* "In littore circa George Town, prope Port-Dalrymple, ins. Diemen septentr. (Gunn, n. 1233!)". Lecto (here chosen): K, labelled, "1233/1842 shrub 2 feet high near Sea George Town 28/1/43". Syn: K, BM.

B. insularis R.Br., Trans. Linn. Soc. London 10:206 (Feb. 1810). *Type citation:* "In Insulis Freti Bass, et in Insula Diemen, prope littora. (ubi v.v.)" Lecto (here chosen): BM, labelled, "12 Banksia insularis prodr. 301. Kings Island April 1802 R.B. obs, e s.s Octr. 1806".

B. integrifolia Labill. ex Meissner in DC. Prodr. 14:456 (Oct. 1856), non L.f. Nomen nudum.

B. marcescens Bonpl., Jard. Malm. 116, t.48 (Sept. 1816), non R.Br. *Type citation:* "Habitat in Nova Hollandia"; the description was based on cultivated material which I have not found. The plate is therefore here nominated as the type.

B. marginata R.Br. (sic) var. *cavanillesii* Endl. in DC. Prodr. 14:455 (Oct. 1856). Nomen illeg., based on *B. marginata* Cav.

B. marginata R.Br. (sic) var. *humilis* Meissner in DC. Prodr. 14:455 (Oct. 1856). *Type citation:* "R. Br. l.c." This refers to Brown's paper in Trans. Linn. Soc. London 10:204 and his var., for which the locality cited was "In Novae Hollandiae orâ orientali; prope Port Jackson: in ericetis. (ubi v.v.)". Lecto (here chosen): BM.

B. microstachya Cav., Anal. Hist. Nat. 1:224 (March 1800)—*B. marginata* Cav. var. *microstachia* (Cav.) Colla, Hort. Ripul. 1:18 (1824); the same combination was also made by Endlicher, Gen. Pl. suppl. 4(2)88 (1848) and by Meissner in DC. Prodr. 14:455 (1856)—*Sirmuellera microstachya* (Cav.) Kuntze, Rev. Gen. Pl. 2:582 (1891). *Type citation:* "Se cria a Jackson viniendo de Paramatta". Lecto (here chosen): MA (photo seen). Collected by Luis Née in 1793.

B. patula R.Br., Trans. Linn. Soc. London 10:205 (Feb. 1810). *Type citation:* "In Novae Hollandiae orâ australi 'Flinders' Land: inter frutices, in sterilibus elevatioribus. (ubi v.v.)". Lecto (here chosen): BM, labelled by Brown "11 Banksia patula marginata var. (crossed out) prodr. 303. South Coast Bay X March 1802". Syn: E, S, UPS. A sheet at K with the number Bennett 3394 (the same as that on the lectotype) has no Brown label, no locality and does not match the lectotype (the perianth is pubescent).

Cotyledons (Fig. 8.4) oblong-obovate, unequally emarginate, 7–9 mm long, ± 3 mm wide, spreading, obscurely 3-nerved, medium green; auricles descending, acute ± 1 mm long. *Hypocotyl* slender, sparsely arachnoid. *Seedling leaves:* first two opposite, close to cotyledons, obovate, obtuse, often mucronate, 10–16 mm long, 4–5 mm wide, with 1 or 2 obliquely triangular, mucronate teeth on each side; lamina flat, loosely hirsute above, white-tomentose below with a hirsute midrib; higher leaves scattered, obovate to narrowly obovate or cuneate, up to 10 cm long, 18 mm wide, obtuse, truncate or emarginate, mucronate; margins flat or slightly recurved, serrate, the teeth 0·5–3 mm long, mucronate; upper surface loosely hirsute becoming glabrous, lower surface closely white-tomentose, nerves concealed except midrib which is hirsute becoming glabrous. *Seedling stem* hirsute.

Mature plant a shrub or tree, sometimes to 12 m with a stout trunk, with or without a lignotuber, sometimes suckering: arborescent plants usually fire-sensitive. *Bark* at first smooth with lenticels, later roughly but finely tessellated, grey, not friable. *Branchlets* hirsute with spreading hairs and tomentose with short curled hairs, the latter usually persistent for 1–2 years; sometimes tomentose only; prophylls at base of shoot subulate, 2–5 mm long, tomentose. *Leaves* scattered, linear, oblong or narrowly cuneate, mostly 1·5–6 cm long, 3–13 mm wide, obtuse, truncate or emarginate, rarely acute, usually mucronate but mucro often deciduous; margins almost flat, recurved or revolute but lower surface always evident, entire, or sometimes serrate leaves persisting to flowering stage or on lateral branchlets; upper surface hirsute to tomentose with ferruginous or pinkish hairs soon becoming glabrous; lower surface white-tomentose, the lateral nerves reticulate and usually conspicuous; midrib below tomentose to hirsute becoming glabrous; petiole 2–5 mm long, tomentose. *Inflorescence* terminal to a branchlet up to 4 years old, sometimes 2 at successive nodes in one season, cylindrical, 4–6 cm wide at anthesis. *Axis* (3)5–10(13·5) cm long, 2–3·5 mm wide, 9–12 mm wide with common bracts, usually without flowers in basal 1 cm. *Involucral bracts* numerous, subulate, 2–10 mm long, tomentose, the outer ones grey, inner ferruginous. *Common bracts* 3–4 mm long, linear, densely hirsute: exserted apex transversely conical, upturned, obtuse, tomentose with

extreme apex sometimes glabrous, pale. *Floral bracts* similar but shorter and narrower, the exserted apex small. *Flowers* pale yellow, often in late bud with grey tinge, rarely golden. *Perianth* 16–24 mm long including limb of 2·5–3·5 mm; ± straight with limb upturned before anthesis; claws 0·2–0·25 mm wide, appressed-pubescent outside, glabrous inside; limb narrowly elliptic, appressed-pubescent, sometimes the hairs rubbing off, 1-nerved. *Anthers* 1–1·5 mm long on short filaments, shortly apiculate. *Hypogynous scales* narrowly triangular, obtuse or acute, 1 mm long. *Pistil* 20–31 mm long, straight or curved downwards, very slender, 0·3–0·5 mm diam. at base, glabrous; pollen-presenter scarcely thickened, 0·75–1 mm long, obtuse, dark in lower half, pale at apex, stigmatic groove slightly oblique; ovary hirsute in upper half, sometimes papillose. *Infructescence* small, 3–4 cm diam., the old perianths and styles usually persistent and downturned, eventually wearing away; involucral bracts often persistent for some time. *Follicles* up to 150, usually many less, often opening when mature but sometimes remaining closed until burnt; in plan view narrowly elliptic, 7–17 mm long, 2–5 mm high, 2–4 mm wide; valves rather thin, convex, smooth, hirsute becoming glabrous, dark brown; ridge narrow; suture very fine; follicles opening to 5–18 mm; lips 0·5–1 (rarely 2) mm wide; lateral beak none. *Seed* obovate-cuneate, 9–15 mm long; seed body ± cuneate-falcate, acute or obtuse at base, 5–8 mm long, 3–4 mm wide, upper margin oblique, lateral margins straight or anti-stylar one convex, narrowly winged; inner surface convex, finely rugose to smooth, black, ± glistening; outer surface convex, smooth to somewhat rugose, black-brown, slightly glistening; wing 8–11 mm wide, sometimes a little oblique, often with a small obtuse beak at stylar point, dark brown. *Separator* similar to seed in shape and size, moderately robust, impressed against not beaked, dark brown; wings slightly recurved near apices.

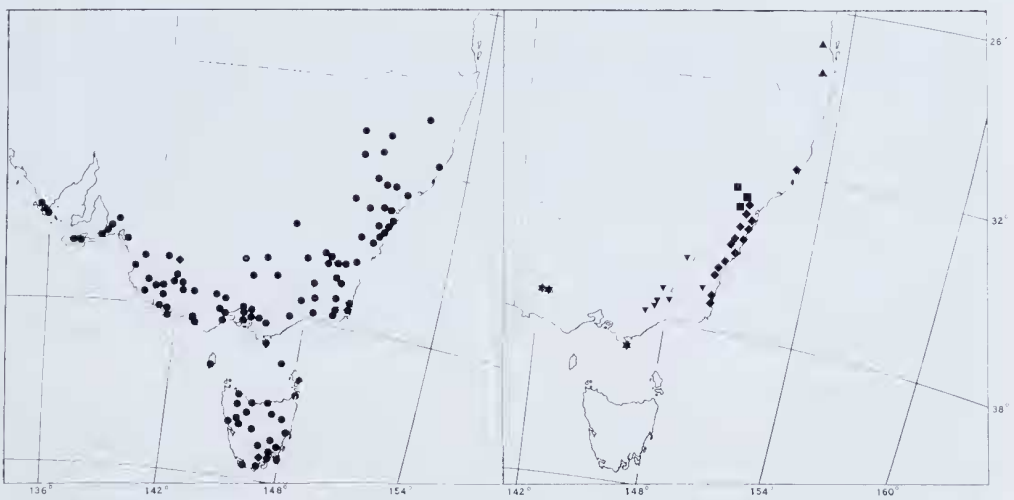


Figure 27. Distribution of *Banksia marginata* (●), *B. canei* (▼), *B. saxicola* (★), *B. paludosa* (◆), *B. conferta* var. *conferta* (▲) and *B. conferta* var. *penicillata* (■).

Distribution. (Fig. 27) Widespread and often common in south eastern Australia, from southern Eyre Peninsula in South Australia through Victoria (except the north west) into New South Wales and A.C.T., as far north as Baradine and Guyra; also on Kangaroo Island, the islands of Bass Strait and throughout Tasmania. Found from sea level to about 1 400 m.

Selected collections. SOUTH AUSTRALIA: S end of Marble Ra., Eyre Peninsula, 24 May 1975, *A. S. George* 13115 (AD, BRI, CANB, MEL, NSW, NT, PERTH); Mt. Lofty Ra., ca. 1·6 km S of Morphett Vale, April 1943, *H. M. Cooper* (AD); MacGillivray, ca. 25 km SW of Kingscote, Kangaroo Is., 30 July 1922, *E. H. Ising* (AD); 22 km N of Kingston, 20 May 1975, *A. S. George* 13100 (AD, BRI, CANB, NSW, PERTH).

VICTORIA: Major Mitchell Plateau, Grampians, 8 Dec. 1962, *J. H. Willis* s.n. (MEL); ca. 22 miles (37 km) SW of Camperdown, NW of Peterborough, 21 Jan. 1969, *A. C. Beauglehole* 7816 (MEL, PERTH); Arthurs Seat, Mornington Peninsula, 24 Feb. 1963, *J. H. Willis* s.n. (MEL); Wilsons Promontory, 1823–1829, *W. Baxter* (BM, PERTH); 7 km E of Cann River, Princess Hwy, 20 June 1974, *A. S. George* 11800 (CANB, MEL, NSW, PERTH).

TASMANIA: 16 miles (25 km) S of Currie by road to Surprise Bay, King Is., 3 April 1978, *M. I. H. Brooker* 5851 (CANB, PERTH); Mt. Nelson, Sept. 1959, *W. D. Jackson* s.n. (HO); Boat Harbour, N of St. Helens, 11 Jan. 1949, *N. T. Burbidge* 3105 (CANB, HO); Blackmans Bay, 11 miles (17 km) S of Hobart, 1942, *W. M. Curtis* s.n. (HO); S of Bathurst Harbour in 43°28′S, 145°05′E, 9 May 1976, *A. S. George* 14257 (HO, PERTH).

AUSTRALIAN CAPITAL TERRITORY: Ca. 1 mile (1·6 km) below Upper Cotter Dam Site, 11 Jan. 1959, *R. Pullen* 1262 (CANB); Gibraltar Falls, 18 Sept. 1967, *H. Reeve* 659 (CANB).

NEW SOUTH WALES: Kanimbla Valley, Aug. 1893, *J. J. Fletcher* (NSW); Mt. Coricudgy (E of Rylstone), 21 Sept. 1948, *E. F. Constable* 27332 (NSW, U, W); Mt. Blaxland to Rydal, April 1909, *J. H. Maiden* and *R. H. Cambage* s.n. (NSW); 14 km along Heathcote Road from Princes Hwy, SW of Sydney, 10 May 1975 *A. S. George* 13066 (AD, BRI, CANB, MEL, NSW, NT, PERTH); 2 miles (3 km) E of Currant Mtn. Gap, 7 miles (11 km) E of Olinda, 1 Sept. 1951, *L. A. S. Johnson* s.n. (NSW); 22 km S of Bombala on Cann Valley Hwy, 14 May 1975, *A. S. George* 13081 (CANB, NSW, PERTH).

Habitat. In a range of soil types—sandy loam, clay loam or shale, often rocky (quartzite, limestone, granite), sometimes in peaty soil in swamps. Associated vegetation may be open shrubland, closed heath, sclerophyllous woodland or forest; also on coastal consolidated dunes.

Flowering period. Mainly February to July.

Banksia marginata vies with *B. integrifolia* L.f. as the most widespread and variable species of the genus, but whereas the latter can be separated into three varieties, *B. marginata* on the basis of current data cannot be so treated. The range in habit from small shrubs to large trees, including fire-sensitive and fire-tolerant forms, and the great variation in leaves, suggest that infraspecific taxa occur, but morphological variation in leaves, indumentum, flowers and fruit is continuous throughout the species. If a part of the geographical range is taken then the variants within it may be distinguished, e.g. on the basis of the leaves, but such distinctions fall down when the whole range is considered.

As is clear from the number of taxa cited above in synonymy, many variants have been named but I accept none of them as valid even at the varietal level. The species warrants a detailed study including field work but this would be a major task in view of the large geographical range.

Presumed natural hybrids with both *B. integrifolia* var. *integrifolia* and *B. conferta* var. *penicillata* have been recorded. The former occurred in two localities on Wilsons Promontory, one just south of Darby River, the other at Scalers Cove. Both parents were present at each site. The hybrids were intermediate in morphology, the most easily noted character being the leaves which were larger than adjacent *B. marginata* and smaller than *integrifolia*. The hybrids with *B. conferta* var. *penicillata* were found on an old disturbed site between Clarence and Newnes in the Blue Mountains and are discussed under the latter species.

Banksia integrifolia is the nearest relative of *B. marginata*, differing mainly in its larger, whorled leaves and larger flowers and fruit, the latter with deciduous old flowers. It is usually a tree and is always fire-resistant. Despite a similarity to *B. canei* J. H. Willis, *B. marginata* is less closely related to it than to *B. integrifolia*. The more rigid, pungent leaves, the stouter flowers, and the more robust infructescence with deciduous old flowers and larger follicles that remain closed for some time, all serve to make *B. canei* quite distinct and probably related more closely to *B. saxicola* A. S. George.

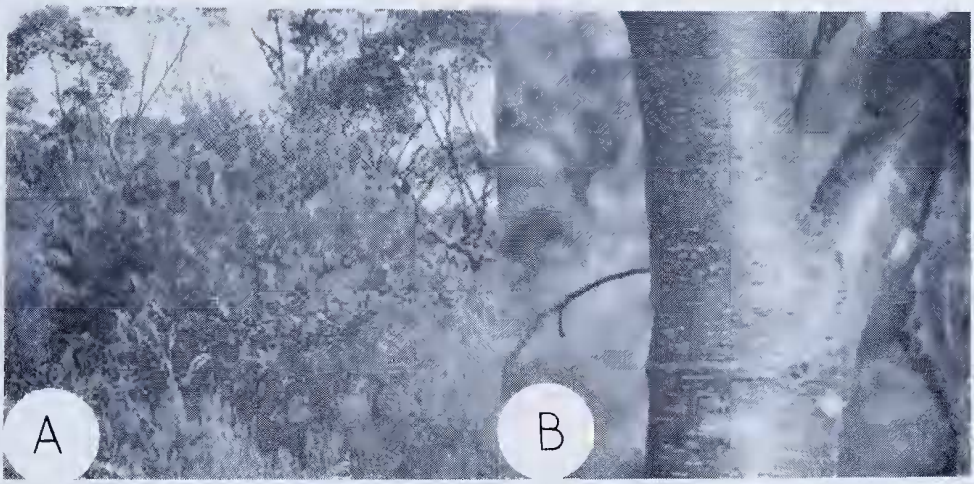


Figure 28. *Banksia canei*. A—Habit, ± 2 m tall. B—Bark. (Both Kydra Reef, N.S.W.).

5. Banksia canei J. H. Willis (Figure 28)

Muelleria 1:118 (July 1967).

Type citation: "Mt. Seldom Seen track, Wulgulmerang, E. Victoria, in montane forest at ± 900 m (2 900 feet) alt.—*J. H. Willis*, 27 Nov. 1962". Holo: MEL; iso: AD, K, MEL, NSW.

Seedlings not seen.

Mature plant a shrub to 3 m tall ? with lignotuber, usually much-branched and up to 4 m across. *Bark* ± smooth with lenticels, at first reddish brown, later grey-brown. *Branchlets* when young villous with short and long pale ferruginous hairs, becoming grey, the long hairs wearing off first; branchlets glabrous after 2–3 years; few or no prophylls at base of shoot. *Leaves* scattered, narrowly elliptic obovate or cuneate, or broadly linear, acute or obtuse, mucronate, mostly 2–5 cm long, sometimes as short as 1 cm or as long as 10 cm, 4–24 mm wide; margins recurved, entire to serrate, the teeth 1–5 mm long, mucronate; sinuses obliquely U-shaped; lower surface hirsute becoming glabrous; sinuses obliquely U-shaped; lower surface hirsute and pubescent with long straight and short curled hairs on nerves becoming glabrous, the lacunae white-tomentose; lateral nerves at an angle of 50°–70° to midrib, reticulate between, sometimes inconspicuous; petiole terete, 2–4 mm long, densely pubescent. *Inflorescence* terminal to 1–3 year old branchlet, usually with a whorl of lateral branchlets below, often on branchlets with dentate leaves, cylindrical, 4–6 cm diam. at anthesis, concealed or conspicuous. *Axis* 5–15 cm long, (usually less than 10), 3–5 mm wide, 10–13 mm wide with common bracts, without flowers for up to 5 mm from base. *Involucral bracts* numerous but many sometimes deciduous before anthesis, subulate, on thick bases; the outer ones 1–5 mm long, grey; inner ones up to 10 mm long, pale brown; all densely tomentose. *Common bracts* linear, 3·5–4·5 mm long, densely ferruginous-hirsute; exserted apex transversely conical, obtuse, slightly upturned, densely tomentose, pale brown. *Floral bracts* similar but narrower and shorter. *Flowers* closely silky, pale pinkish-mauve in bud, pale yellow at anthesis, the limb often greyish or blue; style pale yellow. *Perianth* (15)18–20 mm long including limb of 3–4 mm, straight with the limb upturned before anthesis; claws 0·3–0·5 mm wide tapering upwards, appressed-pubescent outside with white hairs becoming longer towards limb, glabrous inside; limb narrowly elliptic; hirsute to pubescent with white hairs. *Anthers* 1·5 mm long on slender filaments, shortly apiculate. *Hypogynous scales* linear to narrowly triangular, obtuse, 1–1·5 mm long. *Pistil* 17–28 mm long, curved gently upwards, glabrous, 0·5–0·75 mm diam. above ovary; pollen-presenter scarcely thickened, obtuse, 1 mm long, slightly wrinkled when dry, reddish brown with pale apex; stigmatic groove slightly oblique; ovary papillose at apex, otherwise glabrous.

Infructescence cylindrical to ovoid, 4–6 cm wide; involucral bracts mostly deciduous; old perianths and styles early deciduous; common and floral bracts somewhat enlarged. *Follicles* up to about 150, mostly remaining closed until burnt but some opening spontaneously after several years; ± elliptic in plan view, 12–18 mm long, 3–8 mm high, 4–9 mm wide, sometimes bent upwards; valves semi-elliptic, convex, smooth, densely villous with pale brown hairs when young, eventually glabrous except at base and grey-brown or grey-green; ridge obtuse; suture slightly impressed, straight or gently curved; follicles opening up to 12 mm wide, slightly recurved; lips ± 1·5 mm wide; no lateral beak. *Seed* obovate, 13–18 mm long; seed body ± lunate, 6–8 mm long, 2·5–4 mm wide, obtuse at base, stylar side straight to concave with apex sometimes forming shallow obtuse beak; inner surface convex, slightly verrucose, glistening, black or dark brown; outer surface ± flat, very slightly rugose, dark brown; wing 8–11 mm wide, margins ± straight, the antistylar margin decurrent about half-way down seed body; dark brown. *Separator* similar to seed in shape and size, moderately robust, impressed against seed body, obtuse to almost acute at base.

Distribution. (Fig. 27) Victoria and New South Wales: subalpine areas of the Great Dividing Range between the Snowy Range, Gippsland, Victoria, and the Tuross River in south eastern New South Wales. There is an outlier at Talbingo in the Bogong Mountains west of the A.C.T. Usually found between 750 and 1 500 metres.

Selected collections. NEW SOUTH WALES: Talbingo, Feb. 1937, *J. C. Wiburd* s.n. (NSW); S side of Tuross R., about 0·5 mile (0·75 km) above Tuross Falls, 26 April 1968, *L. A. S. Johnson* and *A. Rodd* 625 (NSW); Kybean, 11 Jan. 1908, *R. H. Cambage* 1994 (NSW); Kydra Reef, S of Cooma, 13 May 1975, *A. S. George* 13077 (BRI, CANB, MEL, NSW, PERTH).

VICTORIA: Wellington R. between Mts. Wellington and Selina, Gippsland, 9 Jan. 1963, *W. Cane* (MEL); Brumby Point, Nunniong Plateau, E Gippsland, 21 Jan. 1971, *A. C. Beauglehole* and *E. W. Finch*, ACB 36356 (MEL, PERTH); Doladruk Track, near Wellington River, 30 Dec. 1975, *A. Salkin* 1092 (NSW PERTH)

Habitat. Usually in rocky soil (granite, rarely sandstone) on slopes and in gullies, in *Eucalyptus* low open-woodland, and in open-heath often with *Casuarina.*

Flowering period. January to June.

Banksia canei is a recently-described species which has become well-known only in the past 20 years. It was first recognised as distinct from *B. marginata* Cav. by Mr. William Cane after whom it is named. It differs from that species in the mucronate leaf apices and lobes, the usually larger flowers with thicker styles and especially in the infructescences which have larger villous follicles that normally remain closed for several years or until burnt, and from which the golden flowers are early deciduous. I am not sure if *Banksia canei* is always lignotuberous; the only indication of its regeneration from the parent stock is in notes with a collection from the lower Yarrangobilly River, N.S.W. (Rodd 966 and Coveny, NSW 106189).

The species is in fact more closely related to *B. saxicola* A. S. George which is much larger in habit and in the whorled leaves, but is otherwise similar in morphology of flowers and fruits. The two species require stratification of the seeds to induce germination.

Some differences from the original description are apparent in the description above, largely because of the greater range of material now available. The original description of the ovary as "4-lobed at base, with 8 bold vertical ribs" is apparently derived from the hypogynous scales which are often appressed to the ovary and difficult to separate from it. The small brown papillae about the apex of the ovary appear always to be present.

A collection mentioned by Willis from Mt. Fulton near Port Davey in south western Tasmania is *B. marginata.* Recent collections from the same locality, in flower and fruit fall quite within the concept of that species.

Banksia canei shows great variation in leaf morphology, as discussed by Salkin and Hallam (1978). Adult leaves are typically entire, but frequently they are sparsely serrate towards the apices, while plants also occur in which adult leaves remain dentate, e.g. Salkin 102. The population at Talbingo has long, dentate leaves (up to 10 cm), penicillate floral bracts and small flowers (perianth 15–16 mm long) but only a few specimens from here have been seen. A miniature variant appeared among seedlings germinated by

Mr. A. Salkin. It remained small, about 12 cm tall, with dentate leaves, inflorescences about 2 cm long, with perianths about 12 mm long. A comparable variant of *B. hookerana* Meissner, found in the wild, is discussed under that species.

Figure 29. *Banksia saxicola*. A and B: Bark, and habit, 2·5 m tall (Summit, Mt. William, Vic.). C and D: Bark, and habit, ± 12 m tall (Near Sealers Cove, Wilsons Promontory, Vic.).

6. Banksia saxicola A. S. George, sp. nov. (Figures 29, 30 and 31)

B. integrifolia auctt. non L.f., e.g. J. H. Willis, A Handbook to Plants in Victoria 2:58 (1972).

Frutex expansus vel *arbor* ad 13 m, sine lignotubero. *Cortex* 2-3 mm crassa. *Folia adulta* lanceolata, elliptica vel obovata, obtusa, 4-10 cm longa, 1-3·5 cm lata, supra tomentosa deinde glabra, atrovirentia, subtus albo-tomentosa, marginibus integris recurvis. *Inflorescentia* 3·5-8 cm longa. *Bracteae involucrales* 5-10 mm longae, dense velutinae. *Perianthium* pallide flavum vel lilacinum limbo cinereo-flavum, 19-33 mm longum limbo 3·5-4 mm, extus arcte pubescens intus glabrum; limbus hirsutus. *Stylus* 23-28 mm longus ± strictus. *Squamae hypogynae* anguste-oblongae, obtusae, 1 mm longae. *Folliculi* 15-17 mm longi, 4-7 mm alti, 5-7 mm lati, valvis laevis dense velutinis aetate glabris. *Semina* 14-16 mm longa; ala elliptico-obovata, 6-9 mm lata; seminis corpus parce lunatum ad anguste obovatum, 9-11 mm longum, 2-4·5 mm latum.

Type: Summit of Mt. William, The Grampians, Victoria, 17 Feb. 1977, *A. S. George* 14398. Holo: MEL; iso: AD, BRI, HO, K, MEL, NSW, PERTH.

Derivation of name. From the Latin *saxum*, a rock, and the suffix–*cola*, a dweller, in reference to the very rocky soil of the natural habitat.

Cotyledons not seen. *Seedling leaves* scattered, elliptic-obovate, 2–3 cm long including petiole of 2–5 mm, 9–15 mm broad; margins ± flat, shortly serrate with mucronate lobes, loosely hirsute above and on midrib, becoming glabrous; densely white-tomentose below. *Intermediate leaves* cuneate, acutely serrate, truncate, mucronate, 4–8 cm long, 2–4·5 cm broad.

Figure 30. *Banksia saxicola.* Isotype, A. S. George 14398 (PERTH).

Figure 31. *Banksia saxicola*. Infructescences showing almost mature follicles (left hand illustration) and with some dehisced follicles (right hand illustration). Both ⅔ size and drawn from A. S. George 13090.

Mature plant a shrub or tree without lignotuber; in exposed situations to 3 m tall, very spreading, much-branched; in sheltered situations erect, to 13 m tall, openly branched; trunk becoming stout. *Bark* 2–4 mm thick, at first smooth with lenticels, brown, becoming rough but not friable, grey, often lichen-covered. *Branchlets* pink becoming brown, at first densely tomentose-hirsute with short crisped and long ± straight ferruginous hairs, becoming glabrous after 2–3 years. *Leaves* whorled, lanceolate, elliptic or narrowly to broadly obovate, obtuse, sometimes shortly mucronate, mostly 4–10 cm long, 1–3·5 cm broad, petiole 5–10 mm long with the leaf margins extending along it as ribs; entire or with a few short, obtuse lobes, margins lightly recurved; the upper surface, lower midrib and petiole also hirsute with long, ± straight hairs, all deciduous; lower surface except midrib closely white-tomentose with fine, matted, crisped white hairs, persisting and obscuring the lateral nerves; lamina coriaceous, dark green and shining above. *Inflorescence* at apex usually of a 2–6 year old branchlet; sometimes produced below a node bearing an infructescence; cylindrical, 5–6 cm diam. at anthesis. *Axis* 3·5–8 cm long, 3–5 mm wide, 11–13 mm wide including common bracts. *Involucral bracts* narrowly triangular to subulate, rather acute, mostly 5–10 mm long, densely velvety with straight and crisped hairs, the outer bracts dark grey-ferruginous, the inner ferruginous, pale where concealed, persistent through flowering and early fruit development, at length deciduous. *Common bracts* linear, 4–5 mm long, densely silky with straight ferruginous hairs in lower part; exserted apex narrowly conical, slightly upturned, tomentose with crisped hairs in upper part, also with long straight hairs. *Floral bracts* similar but shorter and narrower, 3 mm long, less silky. *Perianth* 19–22 mm long, including limb of 3·5–4 mm long, yellow-cream with a greyish-cream limb; claws filiform, shortly and closely pubescent outside

with straight, white hairs, quite glabrous inside; limb narrowly lanceolate, almost acute, densely and closely hirsute; perianth relaxing at anthesis, style projecting 4–8 mm. *Anthers* ± 1 mm long on filaments of 0·5 mm, very shortly apiculate. *Hypogynous scales* narrowly oblong, obtuse, sometimes bilobed, ± 1 mm long. *Pistil* slender, 23–31 mm long, curved slightly downwards then upwards, glabrous; pollen-presenter slightly thickened, obtuse, 1·5 mm long, brown with pale apex, stigmatic groove small, oblique; ovary with straight, erect hairs on dorsal and ventral sides at top, fewer and shorter in between, otherwise glabrous. *Infructescence* of many follicles (av. 20–60), the old flowers soon deciduous; bracts becoming indurated. *Follicles* in plan view narrowly elliptic, 12–20 mm long, 4–7 mm high, 5–7 mm wide; suture fine; valves semi-elliptic, convex, densely velvety with both crisped and ± straight hairs, pale ferruginous to cream, wearing off to leave valves smooth or slightly wrinkled and grey; follicles commence opening with seed mature (12–15 months) and continue over several years; lips 2–3 mm broad, dark brown. *Seed* 14–19 mm long; seed body shallowly lunate to narrowly obovate, 9–11 mm long, 3–4 mm wide, apex shortly produced, base obtuse to acute, both surfaces dull grey-black but glistening, often obscurely mottled with brown, outer surface slightly longitudinally rugose, inner ± smooth; wing elliptic-obovate, 9–15 mm wide, the apex somewhat oblique, dull brown. *Separator* 15–18 mm long with transversely elliptic wings 8–13 mm wide, tapering into a narrowly triangular base, impressed by seed body.

Distribution. (Fig. 27) Victoria, in the Grampians and on Wilsons Promontory.

Selected collections. Jimmy's Creek, foot of southern spur of Major Mitchell Plateau, Grampians, 3 Nov. 1952, *R. Melville* 1979 (BRI, K, MEL, PERTH); Near Mt. Thackeray, Victoria Range, Grampians, 2 July 1974, *A. S. George* 11814 (CANB, PERTH); Wilsons Promontory, inland from Sealers Cove, 24 May 1978, *A. Salkin* 129 (Monash).

Habitat. In the Grampians *B. saxicola* grows above 600 m both on exposed summits and in sheltered gullies and slopes; in both habitats the soil is loam among sandstone boulders. Associated vegetation is open-scrub in exposed areas, tall shrubland or open *Eucalyptus* forest (e.g. *E. baxteri*) in sheltered areas. On Wilsons Promontory the species occurs at 200–300 m or higher on hillsides in loam among granitic rocks, in tall closed or open-forest.

Flowering period. January to March.

For many years this species has been regarded as a variant of *Banksia integrifolia* L.f. (e.g. Willis, 1972), but I consider it worthy of specific rank. It differs from *B. integrifolia* in the thinner, smoother bark, the thick, dark green leaves, the greyish-yellow flowers produced in summer, and the larger tomentose follicles that remained closed for 1-several years. The populations in the Grampians are well-removed from the nearest *B. integrifolia* which are on the eastern side of Port Phillip Bay. Those on Wilsons Promontory are close to some stands of *B. integrifolia* at Sealers Cove but are 2–3 km inland in a very different habitat.

The closest relative of *B. saxicola* is probably *B. canei* J. H. Willis which, like the Grampians populations of *B. saxicola*, is a montane plant but of higher elevation. Both species have coriaceous, dark green leaves, similar flowers, and tomentose follicles that remain closed for some years. *Banksia canei* is easily distinguished from *B. saxicola* by its scattered, smaller leaves.

On Wilsons Promontory the plants are all arborescent, straight and tall, being understorey trees of tall forest. In the Grampians they are more branched, lower and spreading even in sheltered situations.

7. Banksia oblongifolia Cav. (Figure 32)

Anal. Hist. Nat., 1:225 (March 1800)—*B. integrifolia* L.f. var. *oblongifolia* (Cav.) Domin, Bibl. Bot. 598 (1921).

Type citation: "Se cria a tres quatros de legua de Jackson". Lecto (here chosen): MA (photo seen); collected by Luis Née in 1793.

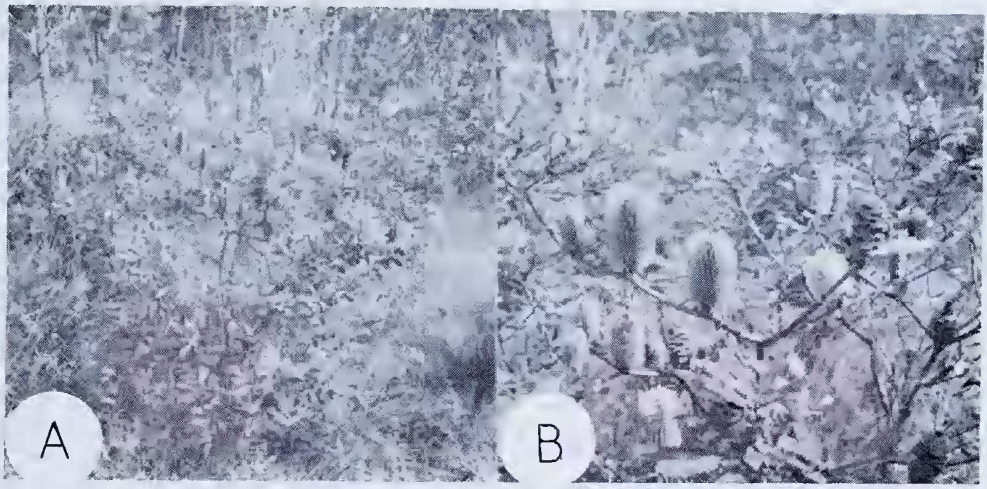


Figure 32. *Banksia oblongifolia*. A—Habit, ± 1·5 m tall. B—Flowers and fruit: upper left branch has 3 inflorescences at successive nodes. (Both N of Maryborough, Qld.).

Banksia latifolia R.Br. var. *minor* Maiden Camfield, Proc. Linn. Soc. N.S.W. 23:265 (1898) (Blake, 1959)—*Banksia robur* Cav. var. *minor* (Maiden Camfield) Maiden and Betche, Census N.S.W. Plants 63 (1916). *Type citation:* none given, nor is any locality cited in the protologue. From several collections at N.S.W. made by Camfield before 1898, I have selected as neotype a sheet—NSW 138266—labelled by him as follows: "Banksia latifolia var. minor Maiden and Camfield Loc. Kogarah June 1897. Coll. Julius H. Camfield". This is a flowering specimen with a small Camfield green tag attached.

B. salicifolia Cav., Anal. Hist. Nat. 1:231 (March 1800). *Type citation:* "Se cria con la precedente" i.e. *Banksia glauca*, for which the locality was "en las cercanias de Bahia botanica junto a la Hakea piri-formis" Lecto (here chosen): MA (photo seen), labelled "ex Nova Hollandia Née iter".

B. asplenifolia auctt. non Salisb., e.g. Beadle et al. (1972).

Cotyledons (Fig. 8.5) obovate-cuneate, rounded to truncate, slightly convex above, 12–15 mm long, 5–7 mm wide, reticulate, ± bright green; auricles spreading to descending, acute, 1·5–2 mm long. *Hypocotyl* less than 1 cm above ground, ± 1 mm diam., finely pubescent, green. *Seedling leaves:* first 2 opposite, 10–13 mm above cotyledons, sessile, narrowly lanceolate, acutely mucronate, 2·5–3 cm long, 4–5 mm wide; margins slightly recurved, acutely dentate, the teeth ± 1 mm long; next leaves in an open spiral, sessile or shortly petiolate, broadly linear, narrowly elliptic or oblanceolate, 3–6 cm long, 6–10 mm wide, acute to truncate, mucronate; margins as in first leaves; all seedling leaves sparsely pubescent above with straight hairs, becoming glabrous; white-woolly below with the midrib pubescent becoming glabrous. *Seedling stem* very sparsely pubescent becoming glabrous. *Lignotuber* beginning development within a year. Following seedling establishment, the next new growth has the stem densely pubescent with both curled and straight hairs; leaves oblong to narrowly obovate.

Mature plant a shrub with lignotuber from which arise several stems up to 3 m tall. *Branchlets* densely tomentose, ferruginous turning dark grey, the lower part without bracts or leaves. *Bark* smooth, red-brown becoming grey-brown, with small lenticels. *Leaves* obovate-oblong, obtuse or truncate, obtusely mucronate, (2)5–8(11) cm long, (1)1·5–2(3·2) cm wide, abruptly narrowed to petiole 2–5(10) mm long; margins slightly recurved, entire at base (occasionally almost throughout), then serrate, the teeth 1(2) mm long; sinuses shallow U-shaped; lamina flat or somewhat undulate, closely tomentose above with curled ferruginous hairs becoming glabrous, tomentose below on midrib and veins with curled hairs which eventually wear off, the lacunae white-woolly, persistent so that mature leaves are white or pale green below; lateral nerves at angle of 70°–80° to midrib, usually forked only near margin and reaching sinuses and teeth apices, reticulate between. *Inflorescence* terminating a 1–3(5) year old branchlet, usually with a whorl of several younger branchlets below. *Axis* (3)5–15 cm long, 4 mm wide, 11–12 mm wide with common bracts; basal 5 mm without flowers. *Involucral bracts:* outermost triangular,

1–2 mm long; inner subulate, obtuse, 3–8 mm long; all densely tomentose with curled, ferruginous hairs; persistent. *Common bracts* linear, 5–5·5 mm long, densely hirsute, exserted apex conical but narrowed to a spreading or ascending point, closely tomentose with crisped hairs. *Floral bracts* narrowly linear, 4 mm long, densely hirsute, the apex shortly conical, tomentose. *Flowers* pale yellow, in bud with grey-blue tinge; styles cream. *Perianth* 22–26 mm long including limb of 4 mm, ± straight but with limb upturned before anthesis; claws ± 0·3 mm wide, glabrous inside, appressed-pubescent becoming appressed-hirsute towards limb, the hairs straight; limb narrowly elliptic, obtuse, appressed-hirsute. *Anthers* ± 1·5 mm long, apiculate. *Hypogynous scales* oblong, truncate or irregularly dentate, 1–1·5 mm long. *Pistil* 2·5 cm long, ± straight or slightly curved downwards above base, glabrous; pollen-presenter narrowly ovoid, 0·7–0·8 mm long, + smooth; ovary glabrous except for apex which is ferruginous-papillose also with a few long straight hairs. *Infructescence* moderately massive, to 17·5 cm long, 3–4 cm diam. usually with follicles throughout; perianths and styles early deciduous; involucral bracts persistent; common and floral bracts slightly enlarged, indurated, ± pungent. *Follicles* up to 80, 1–1·8 cm long, 2–7(10) mm high, 3–7 mm wide; valves depressed semicircular, slightly convex, smooth, velutinous but indumentum wearing off exposed parts; ridge straight or somewhat undulate, acute to obtuse; suture very fine; the whole follicle usually turned upwards slightly; follicles opening 6–12 mm, slightly recurved; lips 0·5–1·5 mm wide, slightly wider at each end. *Seed* obovate 12–18 mm long; seed body ± oblong to semi-elliptic, 7–11 mm long, 3–7 mm wide, base ± obtuse, apex rounded, with a small beak to stylar point which forms slight kink; inner face convex, slightly rugose, grey-brown to black; outer face flat with rounded edges, dark grey-brown; wing ± evenly rounded, 7–11 mm wide, decurrent along seed body on side opposite stylar point. *Separator* similar to seed in shape, 12–18 mm long, 10–12 mm wide, impressed by seed body; wings slightly recurved; no stylar beak; base acute to obtuse.

Distribution. (Fig. 33) Queensland and New South Wales; mostly in near-coastal areas between Bundaberg (Q) and Ulladulla (N.S.W.); an outlying area south east of Blackwater on the Blackdown Tableland (Q); also on Fraser Island (Q).

Selected collections. QUEENSLAND: 10 km N of Bundaberg, 12 April 1970, *D. E. Boyland* 1503 (BRI); Blackdown ca. 12 miles (20 km) SSE of Bluff, July 1964, *C. H. Gittins* 869 (BRI); Mt. Tunbubudla, Glasshouse Mts, 10 Aug. 1930, *C. E. Hubbard* 3644 (BRI, K, S).

NEW SOUTH WALES: 3·6 km N of Kew, Pacific Hwy, S of Port Macquarie, 30 April 1975, *A. S. George* 13027 (BRI, CANB, MEL, NSW, PERTH); half-way, Cordeaux Dam to Mt. Keira, 9 May 1951, *L. A. S. Johnson* (NSW); 2 miles (3 km) W of Wattamolla, Royal National Park (7 miles SSE of Sutherland); 8 April 1970, *R. Coveny* 2895 (NSW, MEL, PERTH, W).

Habitat. In a wide range of conditions; sometimes in seasonably damp sites at the margins of swamps in clay-loam or sandy clay, in sclerophyllous open-forest or woodland, and in tall shrubland (Wallum, Qld); also in sand on sandstone or granite on higher ridges, again in sclerophyllous open forest, e.g. with *Eucalyptus* or *Angophora;* often locally common.

Flowering period. March to June, with a few flowers as late as August.

I consider *Banksia oblongifolia* Cav. (1800) to be the correct name for this species, over which there has been much discussion in recent years. The name was used by Brown (1810) and Meissner (1856), but Bentham (1870) reduced it to synonymy under *B. integrifolia* L.f. In 1898 Maiden and Camfield published the name *B. latifolia* R.Br. var. *minor* for the taxon, and in 1916 Maiden and Betche transferred this varietal epithet to *B. robur* Cav. The name *B. oblongifolia* Cav. was later taken up for the species in Queensland, but in New South Wales *B. asplenifolia* Salisb. was used, a name published in 1796 and doubtfully referred by Robert Brown to *oblongifolia*. The decision to use Salisbury's epithet in New South Wales was based on:

1. the assumption that Robert Brown was correct in placing it with *B. oblongifolia;*
2. the application of the principle of priority which gave it precedence over *B. oblongifolia* (L. A. S. Johnson, pers. comm.)

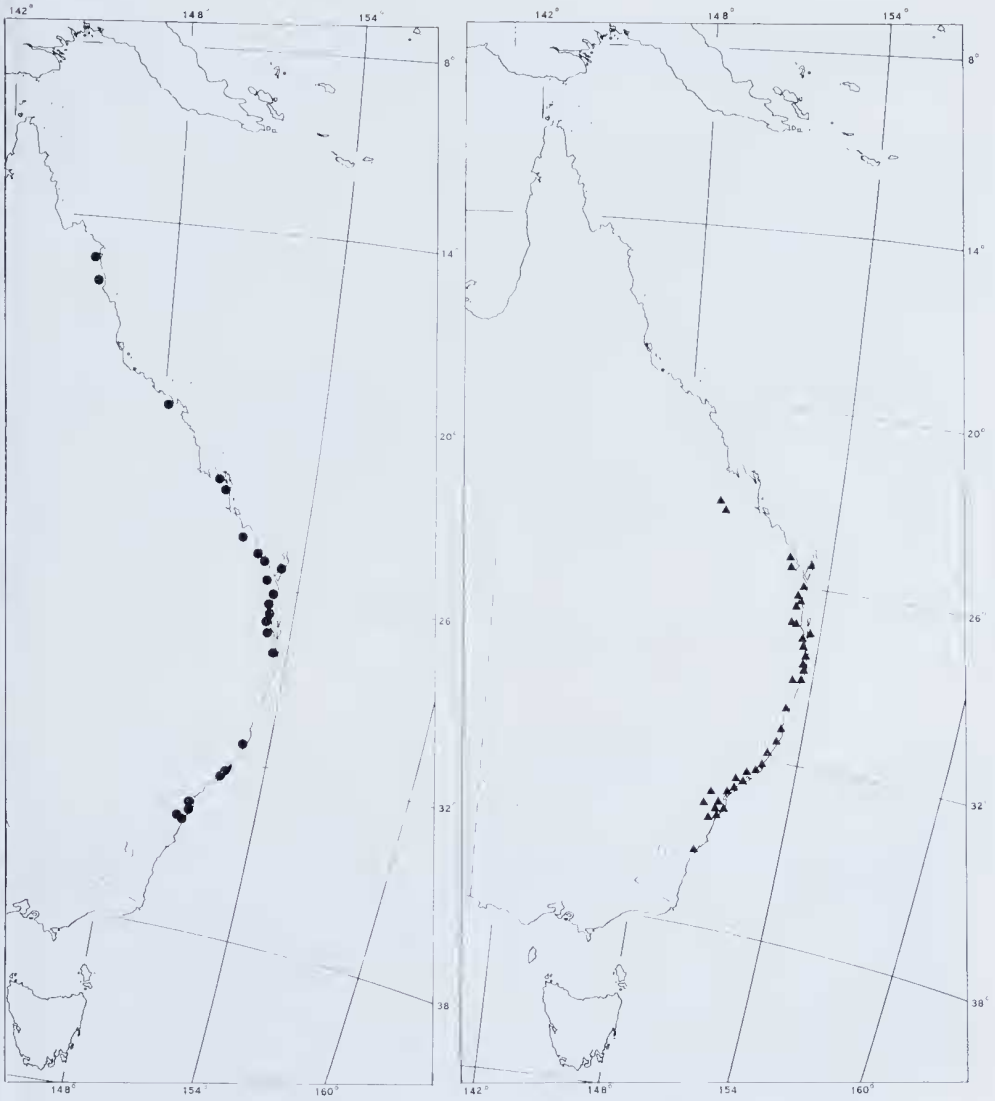


Figure 33. Distribution of *Banksia robur* (●) and *B. oblongifolia.* (▲).

In Queensland, however, the use of Cavanille's epithet continued because of the lack of evidence for applying Salisbury's epithet to the taxon (notes by S. T. Blake, BRI).

The original description of *B. asplenifolia* was as follows:

> "6.B. foliorum laminis rectis, spatulato-lanceolatis, breve serratis, plus minus truncatis cum mucrone, supra glabris, subtus tomentosis, planis.
>
> Ex *Port Jackson* auct. Jac. Lee."

This description could apply to *B. oblongifolia* Cav. (1800), *B. paludosa* R.Br. (1810), juvenile *B. integrifolia* L.f. var. *integrifolia* (1781) or even juvenile *B. marginata* Cav. (1800). These taxa in the Sydney region can all have spathulate-lanceolate leaves, shortly serrate, and tomentose below. The leaf margins may be flat or recurved. The reference to the lamina as straight also gives no clue, as it was used by Salisbury to contrast with

"laminis obliquis" in the description of *Banksia oleaefolia* (= *Hakea dactyloides* (Gaertn.) Cav.) in which the lamina is falcate. Nor does the epithet *asplenifolia* help. It probably refers to the leaf serration and venation, which in the species listed are only subtly different.

Salisbury probably based his description on cultivated material (Bentham 1870, p. 555). No contemporary sheets annotated with his epithet have been found. Those of *B. oblougifolia* were either labelled with Cavanille's epithet or incorrectly determined as other taxa. There is no Salisbury sheet at K or BM. Further, no more detailed description exists in the Salisbury manuscript at BM.

Robert Brown (1810a) cited *B. asplenifolia* in synonymy under *B. oblongifolia*, but, as with *B. serratifolia* under *B. aemula*, with a question mark. He also was apparently uncertain as to the application of the names. Because there is still no firm justification for applying *B. asplenifolia* to a particular species, the name is therefore rejected. The species is correctly known as *Banksia oblongifolia* Cav.

Banksia oblongifolia is quite variable, as would be expected in a species which occupies a wide range of habitats. The variation is fairly continuous, however, in characters such as leaf size, indumentum, length of inflorescence and follicle size. No infraspecific division can be made. The leaves are sometimes almost entire, e.g. Crows Nest, Darling Downs, C. T. White (NSW). In new growth the indumentum occasionally is sparse, e.g. 0·5 km N of Little Bay, Arakoon, L. A. S. Johnson 7869 (NSW).

The closest relative of *B. oblongifolia* is *B. robur* Cav., which differs essentially in the much larger leaves and the metallic green flowers with less hirsute indumentum. In a number of localities the two species grow close to each other, with *robur* usually in the wetter situations. When this occurs, presumed hybrids between them are often found, e.g. at Calga near Gosford, D. J. McGillivray; 6 miles (10 km) S of Commodore Heights, W of Pittwater, L. A. S. Johnson; near Cordeaux Dam, A. S. George.

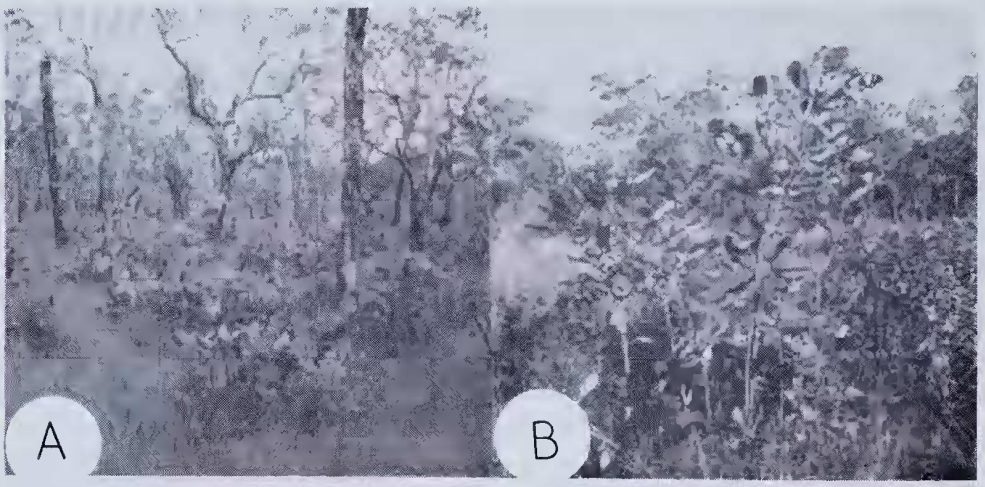


Figure 34. *Banksia robur*. A—Habitat (S of Howard, Qld.). B—Habit, 1·8 m tall; several stems from lignotuber (NW of Howard, Qld.).

8. Banksia robur Cav. (Figure 34)

Anal. Hist. Nat. 1:226 (March 1800)—*Sirmuellera robur* (Cav.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Crece en la Bahia botanica y en el pueblo Jackson". Lecto (here chosen): MA (photo seen) labelled "inter Jackson et Botany Bay arbor 25–30 pedes alta. Née dedit" and determined as *Banksia robur* by Cavanilles. Two other sheets at MA are probably syntypes.

B. dilleniaefolia J. Knight, Prot. 112 (Dec. 1809), nom. illeg., superfl. Type: as for *B. robur* Cav.

B. fagifolia Hoffsgg. Verz. Pfl. Nachtr. 2:66 (1826). No type cited. The description was based on cultivated material and covered only the leaves. It appears to apply to *B. robur*. At B, L, C and S there are sheets bearing this name, all of *B. robur*.

B. latifolia R.Br., Trans. Linn. Soc. London 10:208 (Feb. 1810). Nom. illeg., superfl. Type: as for *B. robur* Cav.

B. longifolia Cav. ex Dietr., Syn. Pl. 1:538 (1839). Nom. superfl. *B. robur* Cav.

B. macrophylla Link, Enum. Pl. Berol. Alt. 1:116 (1821). *Type citation:* none given. The plants described in this work were cultivated at the Berlin Botanical Garden. The description of *B. macrophylla* (leaves only) fits *B. robur*.

B. uncigera J. Knight, Prot. 112 (Dec. 1809). *Type citation:* "I have not seen this in any collection, except the Duke of Northumberland's at Sion House". Knight cited *B. oblongifolia* Cav. in synonymy but his description fits *B. robur*.

Cotyledons (Fig. 8.6) elliptic-obovate, rounded to truncate, flat or ± convex, 15–16 mm long, 8–9 mm wide; venation reticulate; auricles spreading acute or obtuse, 1–2 mm long. *Hypocotyl* 5–8 mm long, 1·5 mm thick, glabrous, pink to red. *Seedling leaves:* 1st 1 cm above cotyledons, lanceolate, 2 cm long, 5 mm wide, acutely dentate; 2nd 3 mm above 1st, similar but slightly larger; then about 1 cm apart, elliptic-obovate, obtuse to truncate, mucronate, 2·5–8 cm long, 0·7–1·5 cm wide, margins flat to slightly recurved, acutely serrate with forward-pointing teeth 0·5–1·5 mm long; all sessile; lamina sparsely pubescent above but soon glabrous, shortly hirsute below on midrib and veins but later glabrous, the lacunae woolly; lateral nerves sometimes forked, finely reticulate between. *Seedling stem* very sparsely hirsute, red. *Lignotuber* beginning development within a year.

Mature plant a shrub with several stems arising from a lignotuber, usually 1–2 m tall but reaching 3·5 m. *Stems* relatively slender, 1–3 cm diam., grey-brown. *Branchlets* densely tomentose with curled, ferruginous hairs, the short ones persisting for 1–2 years, then glabrous; lower part of branchlet leafless but when young bearing scattered short, thick, tomentose prophylls. *Leaves* obovate-elliptic, truncate to emarginate but shortly and obtusely apiculate, (9)12–30(34) cm long including the petiole of 1·4(6) cm, (4)5–9(17) cm wide; margins undulate, slightly recurved, serrate for most of length or almost entire, the teeth (1 at each nerve end) triangular 1–9 mm long, apex mucronate and turned forwards; sinuses shallowly U-shaped; nerves many, at 80–85° to midrib, ± straight at first then gently curved forwards, ± parallel, occasionally forked, sometimes with lesser nerves between and reticulate; upper surface loosely tomentose with short, curled hairs, soon glabrous; lower surface densely tomentose with curled hairs, ferruginous to pale brown on main nerves which become glabrous, leaving white wool in lacunae; midrib prominently raised; petiole remaining closely tomentose. *Inflorescence* terminating a 1–2 year old leafy branchlet, often with one or several new branchlets below. *Axis* 10–17 cm long, 4–9 mm wide, 16–22 mm wide with common bracts, bearing flowers throughout excepting about 1 cm at the base. *Involucral bracts* very thick, the outermost triangular-ovate, 3–6 mm long, inner ones similar at base but produced into narrow, obtuse apices and up to 18 mm long; densely tomentose with curled hairs, outer ones grey, inner dark ferruginous; bracts persistent through flowering. *Common bracts* linear, 7–8 mm long, densely hirsute; the exserted apex conical, slightly upturned and acute, tomentose. *Floral bracts* similar but 7 mm long, the apex very small. *Flowers* with greenish-cream claws and metallic green limb, turning dull gold after anthesis, then brown; pistil cream to pale green; flowers strongly honey-scented. *Perianth* 22–26 mm long including limb of 3–4 mm, straight but limb sharply upturned just before anthesis; claws 0·4 mm wide, shortly appressed-pubescent outside, glabrous inside, except a few hairs below limb; limb narrowly fusiform, almost acute, glabrous with prominent midrib and marginal nerves. *Anthers* ± 1 mm long, prominently apiculate. *Hypogynous scales* broadly linear, 1·5 mm long, obtuse to truncate. *Pistil* 28–33 mm long, glabrous, almost straight except sometimes a sharp upward turn below apex prior to anthesis; afterward slightly curved upward; pollen-presenter narrowly ovoid, 0·75 mm long, ± smooth, but wrinkled on drying; ovary glabrous except a few short, ferruginous hairs in upper half. *Infructescence* fairly massive; old perianths and styles persistent for many years, sometimes at length wearing away. *Follicles* up to 100, sometimes more, opening with fire; in plan view narrowly elliptic,

10–16 mm long, 5–8 mm high, 4–6 mm wide; valves ± smooth but densely tomentose; ridge ± smooth, suture fine. *Seed* obovate, 15–20 mm long; seed body ± triangular but upper margin obliquely rounded, 10–11 mm long, 4–5 mm wide; margins narrowly flanged; inner face ± convex, slightly rugose to smooth, matt black; outer face ± flat, smooth, dark grey-brown; base acute; wing almost evenly obovate but + flattened on top, 8–10 mm wide, somewhat wrinkled, dark brown inside, grey-brown outside. *Separator* similar to seed in outline and size, dark brown; base acute.

Distribution. (Fig. 33) Queensland and New South Wales. There are two principal areas, one from Kempsey to Wollongong in New South Wales, and one from Shoalwater Bay to Coolangatta in Queensland. There are outlying populations in Queensland near Bowen and between Mareeba and Cooktown. The species occurs on the coastal plain.

Selected collections. QUEENSLAND: Between McIvor River and Cape Flattery, 23 Nov. 1972, *A. W. Dockrill* 627 (QRE); Bowen, 9 Sept 1955, *B. Kaspiev* 1043 (NBV); Traveston, mouth of the Burrum River, 6 Oct. 1929, *C. T. White* 6387 (BRI); Six Mile Creek near Caboolture on Bruce Hwy, 21 March 1953, *R. Melville* 3543 (BRI, K, MEL).

NEW SOUTH WALES: Nelson Bay, 15 Feb. 1965, *G. M. Lithgow* 88 (NSW); Dee Why Lagoon 4 miles (6 km) N of Manly, 18 March 1954, *J. H. Willis* (MEL); 2 km NW of Cordeaux Dam, 6 May 1975, *A. S. George* 13058 (NSW, PERTH); Botany Bay, April-May 1770, *J. Banks* and *D. Solander* (BM).

Habitat. In sand or peaty sand, usually seasonally or permanently damp, in *Eucalyptus* or *Melaleuca* low woodland, and in thick sedge-shrubland formations; often locally common especially in south eastern Queensland.

Flowering period. January to July.

Banksia robur is remarkable for its large leaves and metallic green or cream-green buds. The leaves are typically 12–30 cm long and 5–9 cm wide but have been recorded up to 34 cm long (NSW 119955) and 17 cm wide (Beauglehole 3616). The habit varies from low and spreading to erect but is often spindly with age. The broken distribution is also unusual but indicates that the species has a long history during which it has spread over a wide range. There is a partial parallel in *B. spinulosa* var. *spinulosa*

The species is closely related to *B. oblongifolia* Cav. differing chiefly in the larger leaves, the closely pubescent flowers and the narrower follicles. In several localities in both Queensland and New South Wales the two species grow together or almost so, and presumed hybrids occur (see discussion under *B. oblongifolia*).

It is interesting to note that Banks and Solander collected a single specimen of *B. robur* at Botany Bay in 1770. Presumably it was not seen by the younger Linnaeus or he would probably have recognised it as another species besides the four he described.

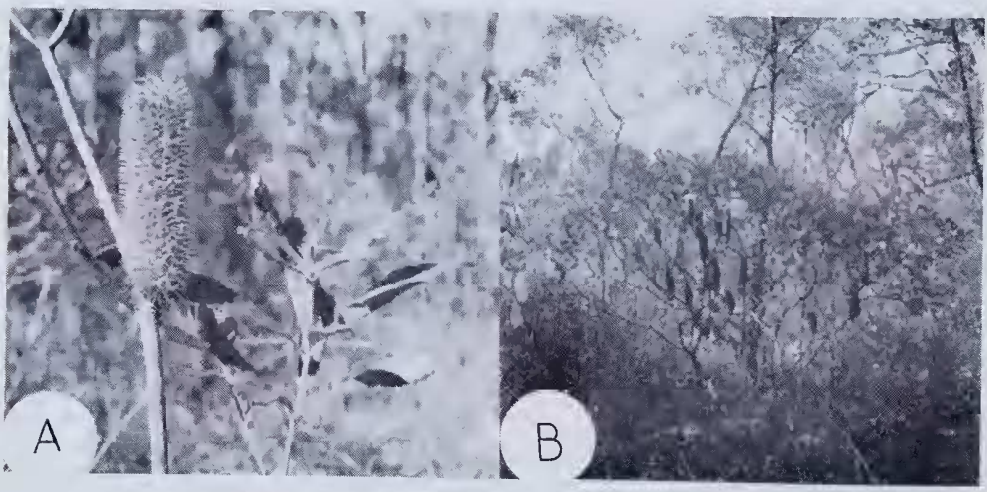


Figure 35. *Banksia paludosa.* A—Inflorescence and whorled leaves. B—Habit, ± 1·8 m tall. (Both near Cordeaux Dam, N.S.W.).

9. Banksia paludosa R.Br. (Figure 35)

Trans. Linn. Soc. London 10:207 (Feb. 1810)—*B. integrifolia* L. f. var. *paludosa* (R.Br.) Benth., Fl. Austral. 5:554 (1870).

Type citation: "In Novae Hollandiae orâ orientali; prope Port Jackson: in paludosis. (ubi v.v.)". Lecto (here chosen): BM; iso: BM, E, K.

Cotyledons (Fig. 8.7) obovate, spreading, 9 mm long, 7 mm wide, emarginate with lobes unequal, ± flat, faintly reticulate, medium dull green; auricles spreading, acute, 2 mm long. *Hypocotyl* slender, 10 mm long, arachnoid. *Seedling leaves*: first 2 or 4 opposite, close above cotyledons; first 2 12–14 mm long, 4–5 mm wide, narrowly obovate, acute, 3/4-dentate on each side, shortly hirsute above becoming glabrous, white-tomentose below, margins slightly recurved; upper leaves progressively larger, narrowly obovate to lanceolate, up to 9 cm long and 23 mm wide, truncate to acute, mucronate, margins serrate with acute teeth 0·5–2 mm long, sinuses obliquely U- to V-shaped; lamina shortly hirsute above but soon glabrous, white-tomentose below. *Seedling stem* shortly hirsute becoming glabrous. *Lignotuber* beginning to form within a year.

Mature plant a shrub to 1·5 m with many stems arising from a lignotuber, sometimes suckering. *Stems* slender, less than 2 cm thick; bark lightly fissured; lenticels small, rounded, 1–2 mm wide. *Branchlets* at first tomentose with curled and straight ferruginous hairs, becoming glabrous by maturity and then reddish-brown; a few deciduous narrowly oblong tomentose prophylls in lower part of branchlet, leafy above. *Leaves* scattered or whorled, more crowded towards shoot apex, ± bright green above, pale below, persistent for up to 4 years, narrowly lanceolate to narrowly obovate, obtuse with a short tomentose-penicillate mucro (usually deciduous); margins recurved, serrate to entire; teeth to 2 mm long, acute, often mucronate; sinus ± 90° or greater, angular to rounded; lamina narrowed to slender petiole 5–13 mm long, the whole leaf 4–13 cm long, 0·5–3·5 cm broad (mostly 1–2·5); lamina at first tomentose above the short, curled, pale ferruginous hairs and a few long, straight ones, soon glabrous; below densely hirsute-tomentose on midrib, lateral nerves hirsute with ± curled hairs (soon deciduous) lacunae closely and densely tomentose with white, matted, persistent hairs; venation on upper surface obscure excepting midrib, on lower surface lateral nerves at 70°–80° to midrib, branching towards margin, yellowish; reticulum evident between lateral nerves. *Inflorescence* at apex of a 3 or more year old branchlet, sometimes below previous inflorescences; 3·2–4 (sometimes 4·5) cm wide, the flowers openly spaced. *Involucral bracts* many, persistent, the outer ones triangular, 2–8 mm long, inner ones subulate, 8–12 mm long, all densely ferruginous-tomentose. *Axis* 7–13 cm long, 3–5 mm wide, 10–12 mm wide with common bracts. *Common bracts* oblong-obovate, 3·5–4 mm long, densely ferruginous-hirsute; exserted apex conical, densely tomentose with crisped white hairs, shorter towards apex which is obtuse, small and upturned or straight. *Floral bracts* similar but narrower. *Flowers* golden brown becoming gold after anthesis; pistil gold to cream. *Perianth* 15–18(22) mm long including limb of 2·5–3 mm, straight; claws slender, filiform, 0·3 mm wide, appressed-pubescent outside, glabrous inside; limb fusiform, obtuse, shortly appressed-pubescent. *Anthers* ± 1·5 mm long with short obtuse apiculum. *Hypogynous scales* very narrowly triangular, entire, ± 1·5 mm long, adhering to perianth in lower half. *Pistil* slender, straight except a slight bend below the pollen-presenter, 17–20(25) mm long, glabrous; pollen-presenter 1 mm long, not thickened, obtuse; ovary hirsute in upper half with long straight hairs. *Infructescence* ± cylindrical, with many follicles ± widely spaced; old perianths and styles persistent for several years, eventually deciduous; bracts somewhat enlarged, indurated, grey. *Follicles* narrowly elliptic, 9–18 mm long, 1–5 mm high, 3–7 mm wide; valves semi-elliptic, gently convex, smooth or slightly wrinkled, shortly hirsute with spreading hairs becoming glabrous; apical ridge narrow but rounded; suture fine; follicles sometimes opening when mature, often remaining closed until burnt; when open up to 9 mm across, not beaked at stylar point, gently recurved; lips 1·5 mm wide. *Seed* obovate, 13–18 mm long; seed body broadly falcate, 8–9 mm long, 3–4 mm wide, base acute; inner face convex, outer flat, black; wing 8–13 mm wide, somewhat flattened across apex, dark brown, decurrent half way down side opposite style, a shallow blunt beak at stylar point. *Separator* similar to seed in shape and size, dark brown.

Distribution. (Fig. 27) New South Wales, along a coastal strip and the nearby mountains from Glen Davis to Womboyn, with an apparent outlier on the coast near Kempsey.

Selected collections. Green Gully, Glen Davis, 25 miles (40 km) N of Lithgow, 27 Sept. 1964, *E. F. Constable* 5142 (NSW); Hat Head, E of Kempsey, Jan. 1966, *L. A. S. Johnson* (NSW); ca. 10 miles (16 km) NNE of Mongarlowe, 23 Sept. 1965, *D. J. McGillivray* 1463 (NSW); Fitzroy Falls, 2 Feb. 1977, *A. S. George* 14393 (PERTH); Clyde Mt., 38 km W of Batemans Bay, 11 May 1975, *A. S. George* 13075 (BRI, CANB, MEL, NSW, PERTH); Centennial Park (Sydney), July 1898, *J. H. Maiden* (NSW); Plateau above Jamberoo Pass, SE of Robertson, 14 April 1964, *R. Pullen* 4050 (CANB).

Habitat. In sandy loam or loam in open *Eucalyptus* woodland or in heath close to swamps; in rocky loam on slopes near creeks in *Eucalyptus* woodland; on sandstone ridges, sometimes moist, of the Blue Mts in heath or woodland.

Flowering period. May to July.

Clearly a member of the series *Salicinae*, *Banksia paludosa* may be easily recognised by its narrow inflorescence with short, golden-brown, openly arranged flowers. Other characteristics are the presence of a lignotuber; the firmly coriaceous leaves with prominent reticulation on the lower side; the stiff, straight styles; and the infructescences with persistent old flowers and small follicles.

The closest relative of *B. paludosa* is *B. conferta* A. S. George var. *penicillata* A. S. George which is a much larger, non-lignotuberous shrub with villous indumentum on new growth, larger leaves but of similar texture and venation, and longer, more crowded flowers.

Banksia paludosa is quite variable in leaf size, in the margins varying from dentate to entire, and in the length of the inflorescence. A collection from Nadgee Nature Reserve (Hope and McGillivray, NSW 86885) has consistently small, mostly entire leaves 2–6 cm long, and 4–11 mm wide. Another, from W of Scarborough (Johnson, NSW 138239) has very broad dentate leaves 1·5–3·4 cm wide: these give it an aspect similar to that of *B. conferta* var. *penicillata* but the inflorescence is that of *paludosa*. Perianth and style length are relatively constant except for a single collection—Culburra, ESE of Nowra, A. S. George 11794—in which the perianth is 21–22 mm long and the pistil 24–25 mm long. The collection also has the leaves entire or almost so but in other respects is typical of the species. Another collection—Jamberoo Pass, R. Pullen 4050—has the perianth 19–20 mm long, but in other respects is typical. What appear to be male flowers are sometimes seen, e.g. a collection from Bundanoon (Cosh, NSW 138241). In one inflorescence the perianth is 11 mm long and the ovules are rudimentary. Another inflorescence in the same collection has perianths 16 mm long and normal ovules. The pollen-presenters are similar in the two inflorescences.

Series **Grandes** A. S. George, series nova.

Frutices vel *arbores*. *Folia* grandia lobis prominentibus triangularibus. *Inflorescentia* in ramulis principalibus terminalia. *Bracteae involucrales* prominentes, persistentes vel deciduae. *Perianthium* rectum praeter limbum ante anthesin sursum flexum. *Pistillum* leviter curvatum, apice sursum flexo; pollinis praebitor parum incrassatus, laevis, 0·2-1·5 mm longus. *Folliculi* multi, non-prominenter exserti, post dehiscentia sine rostro laterali. *Semina* anguste cuneata-obovata; seminis corpus laeve, lateraliter non alatum.

Type species: Banksia grandis Willd.

Shrubs or *trees*. *Leaves* large with prominent triangular lobes. *Inflorescence* terminal to main branchlets. *Involucral bracts* prominent, persistent or deciduous. *Perianth* straight except for limb being upturned before anthesis. *Pistil* gently curved with ± upturned apex; pollen-presenter slightly thickened, smooth, 0·2–1·5 mm long. *Follicles* numerous, not prominently exserted, without lateral beak after opening. *Seeds* narrowly cuneate-obovate; seed body smooth, not laterally winged.

Derivation of name From the Latin *grandis*, large, the specific epithet of the type species, in reference to the leaves.

This series contains two species, viz. *B. grandis* Willd. and *B. solandri* R.Br., both endemic in South West Western Australia. The two are closely related to each other but not to other species of the genus. The important diagnostic characters of the series

are the large, prominently lobed leaves, the very small, smooth pollen-presenters, the follicles that are not laterally beaked after opening and the narrowly cuneate-obovate seeds and separators.

Meissner (1856) placed *B. grandis* in his series *Dryandroideae* and *B. solandri* in the *Quercinae*, while Bentham (1870) placed them in the section *Cyrtostylis*. All of these taxa were heterogeneous, and the series *Grandes* is described here to accommodate the two species.

The presence of the unbeaked open follicles and the little-modified perianths and pollen-presenter indicate that the series is perhaps an early offshoot from the *Salicinae*. While one species, *B. grandis*, has become widespread and common in the South West, *B. solandri* is probably a derivative that has remained confined to the Stirling Range.

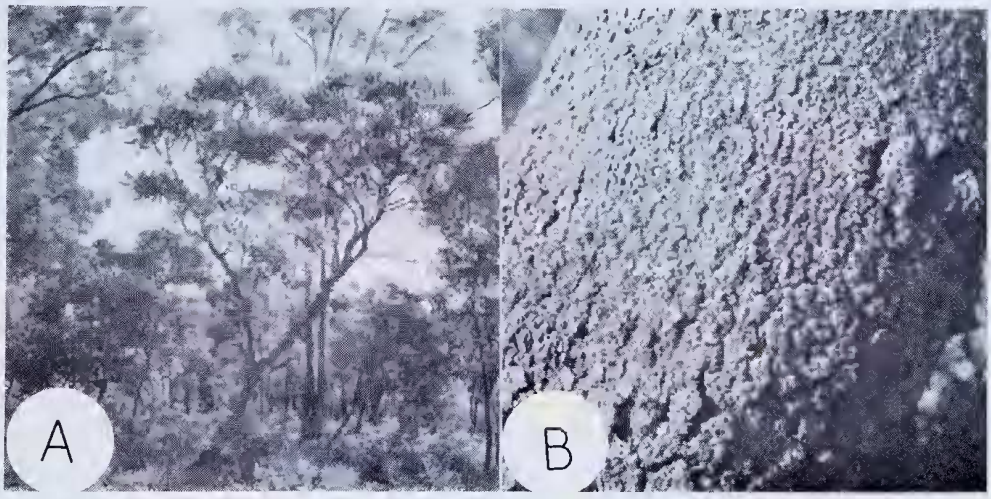


Figure 36. *Banksia grandis*. A—Habit, ± 8 m tall. B—Bark. (Both Roleystone, W.A.).

10. Banksia grandis Willd. (Figure 36)

Spec. Plant. 1:535 (1798)—*Sirmuellera grandis* (Willd.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "*Habitat* in Nova Hollandia (v.s.s.fl.)". Lecto (here chosen): B 2465, ex Herb. Willdenow. The sheet contains two leaves and was annotated by Willdenow. The material is from a cultivated plant, presumably raised from seed collected in 1791 by Archibald Menzies at King George Sound, Western Australia.

Cotyledons (Fig. 8.8) obovate-cuneate, slightly oblique, 12–21 mm long, 9–14 mm wide, widely spreading, flat to convex, deep green, midrib slightly evident; auricles pendulous to spreading, acute, 1–2 mm long. *Hypocotyl* pubescent. *Seedling leaves:* first 2 opposite, 1–3 mm above cotyledons, obovate-cuneate, 2–4 cm long, 1·3–2·1 cm wide, ± truncate but with several small apical lobes, the margins divided almost to midrib into 3–4 lobes; lobes ± triangular but the distal side 3–9 mm long and shorter than proximal, 3–11 mm wide, acute; sinuses ± acute; lamina sparsely hirsute above, white-cottony below except midrib which is sparsely hirsute; higher leaves scattered but ± crowded, similar but becoming larger and with more lobes. *Seedling stem* densely hirsute.

Mature plant a tree to 10 m, or in south coastal areas a spreading, woody shrub. *Bark* 1–3 cm thick, finely rugose, friable. *Branchlets* stout, when young angular-striate, later faintly striate to smooth; densely tomentose with ferruginous hairs becoming grey and persistent for 2–3 years; lower part of branchlet without leaves but bearing prophylls that are linear-subulate, obtuse, thick, densely tomentose at base, hirsute above, soon deciduous. *Leaves* obovate-cuneate in outline, truncate with an obtuse mucro (often produced into an awn in young leaves), 10–45 cm long, 3–11 cm wide, divided to midrib

into triangular lobes that are opposite to alternate, slightly overlapping at base; lobes mostly 2–5·5 cm long, 1·5–5 cm wide at base, the apical and basal lobes smaller, obtuse with the apex somewhat upturned, margins flat but whole lobes often strongly recurved; upper surface tomentose with curled, ferruginous hairs becoming glabrous, midrib impressed; lower surface also densely tomentose but the hairs longer and coarser on midrib, becoming glabrous except for white wool in the lacunae and sometimes short curled hairs on midrib; midrib very prominent; lobes each with 3–4 main nerves ± at 90° to midrib but converging upwards, only the central one reaching apex; also several lesser nerves and finely reticulate between; main nerves only slightly evident on upper surface. *Inflorescence* terminating branchlet usually of previous growing season, sometimes on an older branchlet and then with a few subtending branchlets, conspicuous. *Axis* 10–40 cm long, 7–10 mm wide, 18–25 mm wide with common bracts, bearing flowers throughout except for a few mm at base and apex. *Involucral bracts* with thickened bases, the outer ones gradually narrowed, 5–15 mm long, obtuse, the inner abruptly narrowed to subulate apices, 10–25 mm long, all densely tomentose with curled grey and brown hairs, apices often hirsute also; bracts mostly persistent to flowering but deciduous in fruit. *Common bracts* linear-oblong, 6–8 mm long, thick, densely ferruginous-hirsute; the exserted apex conical, straight to upturned, densely tomentose with curled hairs and a few long ones. *Floral bracts* similar but slightly smaller with less prominent apices. *Flowers* pale yellow, the limb often tinged with grey or turquoise; styles cream. *Perianth* 26–35 mm long including limb of 4–5 mm, straight, the limb upturned just before anthesis then slightly relaxing; claws narrow-linear, 0·5 mm wide, 3-nerved, the lower 2/3 glabrous, then hirsute outside and inside; limb broadly fusiform, obtuse, thick, glabrous. *Anthers* ± 1·5 mm long, broad, with a prominent obtuse apiculum. *Hypogynous scales* narrowly triangular, obtuse, free, 1·5–2 mm long. *Pistil* 35–40 mm long, curved gently down then up, the pollen-presenter straight, glabrous including the ovary; pollen-presenter slightly thickened, obtuse, smooth, 1–1·5 mm long. *Infructescence* massive, 10–40 cm long, 7–9 cm wide, the axis much thickened, common and floral bracts indurated, perianths early deciduous; apical section often without follicles and then not much enlarged. *Follicles* numerous, elliptic in plan view, 17–25 mm long, 3–10 mm high, 6–12 mm wide; valves semi-elliptic in side view, ± smooth but wrinkled to verrucose along suture, densely tomentose with short curled hairs that wear off exposed areas; follicle opening when seed mature, to 10–17 mm, valves moderately recurved; lips ± wrinkled, 1 mm wide, fairly even. *Seed* obovate, 32–38 mm long; seed body ± obovate with upper margin obliquely rounded, 12–16 mm long, 7–9 mm wide; inner surface convex, smooth, grey-black, glistening, without apical ridge, base obtuse; outer surface ± flat, but with longitudinal irregular wrinkles and small brown irregular tubercles, otherwise grey; wing 15–20 mm wide, sides ± straight, apex flattened, thin except for a thickened stylar vein, smooth, pale brown with scattered mottling; a notch or step in the wing margin above stylar point. *Separator* similar to seed in shape and size, smooth, brown, the wings shortly recurved when dry.

Distribution. (Fig. 38) South West Western Australia; from Mt. Lesueur south to Cape Lecuwin and east to Cape Riche, extending inland to Woodanilling.

Selected collections. SE side of Mt. Lesueur, 9 March 1979, *R. J. Cranfield* s.n. (PERTH); Near Fremantle, no date, *Oldfield* 695 (MEL); Wooroloo, Nov. 1907, *M. Koch* s.n. (NSW); Yallingup, 29 Sept. 1914, *C. H. Ostenfeld* 719 (C); Karagullen, Brookton Hwy, 6 Oct. 1976, *A. S. George* 14385 (PERTH); Near Cape Riche, 20 Nov. 1840, *L. Preiss* 492 (LD); Road to Bluff Knoll, Stirling Ra., 27 Sept. 1966, *R. Filson* 9887 (MEL); King George Sound, 1898, *R. Collie* s.n. (NSW); ± 13·5 km W of Woodanilling, 27 Sept. 1977, *A. S. George* 14918 (PERTH).

Habitat. On the western coastal plain in brown or grey sand as a component of woodland, usually with *Eucalyptus marginata* Donn ex Sm. or *E. gomphocephala* DC.; on the Darling Plateau in laterite as a common understorey tree in open-forest and woodland of *Eucalyptus marginata* and *E. calophylla* R.Br.; near the south coast as an emergent above low open heath.

Flowering period. Mainly October to January.

Banksia grandis is a distinctive species, easily recognised by its large leaves with prominent triangular lobes; its large inflorescences with crowded pale yellow flowers; its partly hirsute perianths; its massive infructescence with many follicles that are not

much exserted but open spontaneously, without a lateral beak; and its cuneate seeds. The species is very common through the forests of the South West and is locally common on the western coastal plain. In these areas it shows little variation other than that usually seen in the size of leaves, flowers and fruit. Along the south coast, however, the habit is different, being a robust spreading shrub up to 3 m tall. A plant raised at Kings Park from seed of this variant has retained its low, spreading habit but although apparently mature (it is now 25 years old) has produced no flowers. At the most inland occurrence, near Woodanilling, the plants are small trees with small leaves and fruits. Flowers from this population have not been seen.

11. Banksia solandri R.Br.

Prot. Nov. 36 (1830)—*Sirmuellera solandri* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid., regio mont. prope King George's Sound, 1829. *D. Baxter.*" Lecto (here chosen): BM; iso: BM; (including infructescence), NSW 130708.

B. hookeri J. L. Drumm., Bot. Mag. Comp. 7 p.1 (1848), nomen nudum pro synon. sub *B. solandri.*

B. solandri R.Br. var. *major* Meissner in DC. Prod. 14:464 (1856). *Type citation:* "In montibus Mongerup prope sinum Regis Georgii (Drumm.)", i.e. Drummond. "Mongerup" is Mondurup in the Stirling Range. Lecto (here chosen): K.

Cotyledons (Fig. 8.9) obovate, spreading, 11–14 mm long, 5–8 mm wide, concave, ± nerveless, margins reddish; auricles spreading, almost acute, 2 mm long. *Hypocotyl* less than 5 mm long, 15 mm thick, pubescent. *Seedling leaves:* first 2 ± 2 mm above cotyledons, cuneate, truncate, obtusely mucronate, 15–16 mm long, 10–11 mm wide; margins slightly recurved, 1–2-lobed each side, the lobes broadly and obliquely triangular, obtuse, 1·5–3 mm long; lamina sparsely hirsute above, hirsute on midrib below and otherwise densely white-woolly but lateral nerves evident; mucro hirsute; lamina narrowed to base but sessile; next 3–4 leaves scattered, 1–2 mm apart, cuneate-obovate, truncate, mucronate, 25–45 mm long, 17–28 mm wide, 3–4 lobed on each side, the lobes acute, 3–7 mm long, slightly imbricate at base, sinuses V-shaped; indumentum as in first leaves; higher leaves progressively larger. *Seedling stem* densely hirsute and tomentose with white hairs.

Mature plant a shrub to 4 m, without lignotuber, openly branched and spreading. *Bark* 2–3 mm thick, smooth with small lenticels or lightly fissured. *Branchlets* ± terete, striate, at first 2·5–4 mm diam., hirsute and densely pubescent at first, ferruginous, becoming closely pubescent and pink, then grey, at length glabrous; prophylls near base of branchlet linear, obtuse, very thick, up to 8 mm long, villous-hirsute. *Leaves* obovate-cuneate, truncate or sometimes retuse, 10–30 cm long, 4–12 cm wide, somewhat undulate; margins slightly recurved, deeply divided on each side into 2–9 lobes; lobes triangular, usually oblique, acute to obtuse, up to 4 cm wide, the margins convex with the distal one the shorter and up to 3 cm long, rarely longer; sinuses mostly V-shaped, sometimes broadly so; lamina hirsute and densely tomentose above becoming glabrous, likewise on midrib below; lateral nerves below sparsely hirsute and pubescent becoming glabrous; lacunae closely white-woolly; lateral nerves at 60°–80° to midrib, with one main nerve and several lesser ones to each lobe, reticulate between; midrib prominent below; petiole 1–4 cm long, densely tomentose and at first loosely hirsute; new growth pale ferruginous-green. *Inflorescence* terminal to main branchlets, usually without lateral branchlets below at anthesis, cylindrical, 4·5–6 cm diam. at anthesis. *Axis* 4–16 cm long, 5–6 cm wide, 14–15 mm wide with common bracts, bearing flowers throughout. *Involucral bracts* linear-terete, obtuse, 5–15 mm long, densely villous, persistent until early fruit. *Common bracts* narrowly linear, ± 5 mm long, densely hirsute but the hairs deciduous on the lower half; exserted apex narrowly conical, ± straight, densely tomentose with curled ferruginous hairs and penicillate with straight pale hairs. *Floral bracts* similar but slightly shorter, the exserted apex small, not penicillate. *Flowers* pale ferruginous to dark brownish-purple, heavily scented; styles cream, brownish-purple just below pollen-presenter. *Perianth* 20–24 mm long including limb of 2–3 mm, straight with the limb sharply upturned before anthesis; claws filiform, 0·4–0·5 mm wide, not much narrowed upwards, densely appressed-hirsute outside, glabrous inside in lower half, hirsute in upper

half; limb fusiform, obtuse, sparsely hirsute with curled and long straight hairs but usually almost glabrous by anthesis. *Anthers* 1 mm long on filaments of 1 mm, shortly apiculate. *Hypogynous scales* narrowly triangular to linear, obtuse, 1·2–1·5 mm long, free. *Pistil* 23–28 mm long, curved gently down, then upturned before anthesis, slender, glabrous; pollen-presenter globular-conical, 0·2–0·3 mm long and wide, smooth; stigmatic groove oblique; ovary glabrous. *Infructescence* massive, 5–8 cm diam.: common bracts enlarged, indurated; old perianths and styles persistent, gradually wearing away. *Follicles* numerous, not prominent, in plan view ± elliptic, 10–18 mm long, 3–8 mm high, 4–8 mm wide; valves semi-elliptic, gently convex, sometimes with a slight transverse ridge, smooth to slightly rugose, densely hirsute when young but soon glabrous; ridge narrow but obtuse, somewhat crenulate; suture impressed; follicles usually opening with fire, to 6 mm wide; no lateral beak; lips 1 mm wide, even. *Seed* cuneate, 20–23 mm long; seed body ± obovate, obtuse at base, 9–12 mm long, 5–6 mm wide, lateral margins gently convex, not winged, upper margin convex, oblique; inner face convex, smooth, black, glistening; outer face unevenly convex, slightly rugose, dark brown, somewhat shining; wing 10–12 mm wide, ± even, dark brown, very finely reticulate. *Separator* similar to seed in shape and size, rather slender, impressed against seed body, thickened but not ridged above, not beaked; wings recurved at apex.

Distribution. (Fig. 38) South West Western Australia; endemic to the Stirling Range.

Selected collections. Slopes of Mt. Warrungup, 6 Oct. 1960, *A. M. Ashby* s.n. (AD); Lower slopes of Mt. Toolbrunup, 28 Sept. 1966, *R. Filson* 9029 (MEL, PERTH); Swan River colony, *J. Drummond* 305 (BM, CGE, G, NY, OXF); N. side of The Arrows, 11 Oct. 1970, *A. S. George* 10437 (PERTH); Summit of Mondurup, 4 Oct. 1902, *A. Morrison* s.n. (PERTH).

Habitat. In rocky soil and in sand among rocks (metasandstones), in tall shrubland or closed heath on slopes and summits; less common in gullies on lower slopes, where occasionally in low woodland.

Flowering period. October to November.

Banksia solandri may be distinguished from *B. grandis* by the shrubby habit; the smaller leaves with fewer, usually obtuse leaves; the villous, persistent involucral bracts; the smaller brownish-purple flowers; the narrow limb with sparse, long, deciduous hairs; the very small pollen-presenter; the infructescences with persistent old flowers; the follicles remaining closed until burnt, hirsute but soon glabrous; and the smaller seeds. Unusual features include the common bracts which shed the dense hairs on the basal half before anthesis, the narrow limb with a few long hairs, the brownish purple flowers which are scented like *Solandra maxima* (Sessé & Mocino) P. S. Green, and the very small pollen-presenter. The last presents its pollen only over the convex apex. The species is closely related to *B. grandis* Willd. and may have developed from it. The two are often sympatric in the Stirling Range but do not hybridise.

Series **Quercinae** Meissner in DC., Prod., 14: 459 (1856).

Shrubs without lignotubers. *Leaves* serrate or rarely entire. *Inflorescence* cylindrical on short lateral branchlet. *Involucral bracts* partly glabrous or tomentose throughout. *Perianth* ferruginous, fawn or pinkish-mauve, straight, the limb awned, not or slightly relaxed after anthesis. *Pistil* straight or gently curved; pollen-presenter narrow, 1·5–4 mm long, smooth or finely ribbed, stigmatic area lateral or a groove. *Follicles* narrowly elliptic to oblong; valves smooth, after dehiscence without or with a lateral beak. *Cotyledons* ovate to obovate.

Type species: **B. quercifolia** R.Br., lecto. nov.

This series contains three species—*B. baueri* R.Br., *B. oreophila* A. S. George and *B. quercifolia* R.Br. The latter two are the more representative of it as here defined, being characterised especially by the awned, non-relaxing perianth, the pollen-presenter with a lateral stigmatic area rather than a groove, and the follicles not beaked ofter opening. Development of the inflorescence is basipetal in *B. quercifolia* and *B. oreophila*, a feature seen otherwise in *Banksia* only in the section *Oncostylis*. The unusual characters are the awned perianth and the presence of a lateral stigmatic area on the pollen-presenter rather than a groove. These have probably developed from an ancestor of the *Salicinae* type,

the links to that series being the unbeaked open follicles and the straight, obovate cotyledons. *Banksia quercifolia* and *B. oreophila* are also unusual in the almost-glabrous new growth.

Banksia baueri is anomalous in the *Quercinae* but is placed here largely on the basis of the awned perianth and the obovate cotyledons. It differs from the two other species mainly in the acropetal floral development, the large, ribbed pollen-presenter with a stigmatic groove, and the beaked open follicles.

Meissner's concept of the *Quercinae*, defined on the basis of leaves alone, was much wider than that adopted here, including 18 species of diverse form, e.g. *B. coccinea* R.Br., *B. sceptrum* Meissner, *B. oblongifolia* Cav., *B. caleyi* R.Br., *B. repens* Labill, and *B. solandri* R.Br. Bentham (1870) distributed them among three of his sections. My concept of the *Quercinae* is much narrower than that of Meissner, and I have rather arbitrarily determined which of Meissner's species would be retained, but was guided partly by the name and its equivalent derivation to that of *B. quercifolia*.

Figure 37. *Banksia quercifolia*. A—Infructescences and inflorescences on short lateral branchlets from older stems; a new inflorescence lower right (Millbrook, N of Albany, W.A.). B—Plant killed by fire, with opened fruit. (E of Walpole, W.A.).

12. Banksia quercifolia R.Br. (Figure 37)

Trans. Linn. Soc. London 10:210 (Feb. 1810)—*Sirmuellera quercifolia* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: in campis prope littora. (ubi v.v.)". Holo: BM, a sheet labelled by Brown "Banksia quercifolia Near the observatory in Princess Royal Harbour, King George IIId Sound. Dec. 1801". There are also 3 infructescences in the carpological collection at BM.

Cotyledons (Fig. 8.10) obovate-oblong, spreading, slightly convex, 9 mm long, 6 mm wide, ± bright green with pale red margins, faintly reticulate; auricles vertical, obtuse, 1·5 mm long. *Hypocotyl* slender, pale green or pink, glabrous. *Seedling leaves*: first 2 opposite, 6–8 mm above cotyledons, linear to narrowly oblanceolate, 9–13 mm long, 1·5–3·5 mm wide, obtuse or mucronate, sessile; margins recurved to revolute, entire or shortly and obtusely dentate towards apex; upper surface loosely hirsute becoming glabrous, lower densely white-tomentose; higher leaves alternate to scattered; third leaf 13–18 mm long and similar to first 2; 4th 25–30 mm long, 8–9 mm wide, margins slightly recurved, lower surface hirsute on midrib and tomentose only in lacunae; higher leaves ± flat, becoming more lobed, upper surface glabrous except for long hairs along midrib when young, lower surface hirsute on midrib becoming glabrous, the lamina tomentose only in lacunae. *Seedling stem* glabrous or sparsely hirsute when young. *New leaves* reddish.

Mature plant an erect shrub to 3 m tall without lignotuber, much-branched, often flowering when less than 1 m. *Bark* at first smooth with lenticels, greenish-brown, becoming lightly tesselated and grey, not friable. *Branchlets* slender, glabrous, red when young, remaining reddish-brown for several years, a few subulate prophylls on lower part of each shoot and around terminal vegetative buds. *Leaves* scattered but more crowded at apices of shoots, narrowly cuneate, truncate but mucronate, 3–15 cm long, 1–4 cm wide, margins flat to slightly recurved, prominently serrate, the lobes 2–9 mm long, both sides ± straight or slightly curved, lobes pungently mucronate with the mucro slightly upturned; lateral nerves ± parallel, at 50° to 70° to midrib but, excepting those to lobe apices, dividing before reaching margin, finely reticulate between; lamina glabrous on both sides except a few straight hairs, and on the lower surface fine wool in shallow lacunae; petiole 1–4 mm long; axil often pubescent. *Inflorescence* terminating a short, lateral leafy branchlet some distance below main branch apex, rarely terminal to main branch, cylindrical. *Axis* 2–10 cm long, 2–3 mm wide, 9–12 mm wide with common bracts, bearing flowers except for 5–10 mm at base and 1–5 mm at apex; floral development basipetal. *Involucral bracts* subulate, triquetrous, 5–10 mm long, glabrous at base, pubescent towards apices; branchlets here pubescent. *Common bracts* ± cuneate but broadened at apex, ± 5 mm long, densely ferruginous-hirsute, the hairs becoming shorter upwards; exserted apex glabrous in upper half, green, obtuse and slightly upturned. *Floral bracts* similar but apex narrower and smaller. *Flowers* yellow, orange or brown, with ferruginous indumentum. *Perianth* 23–27 mm long including limb of 3–3·5 mm and awn of 4–5 mm ± straight but awns bent downwards; claws narrowly linear, ± 0·5 mm wide, slightly narrowed below limb, glabrous outside at base, densely silky-pubescent above becoming hirsute below limb; hirsute inside in upper half, otherwise glabrous; limb narrowly fusiform, obtusely keeled, hirsute at base, appressed-pubescent above; awn filiform, appressed-pubescent outside, glabrous inside. *Anthers* ± 5 mm long including short apiculum; filament thick, 1 mm long. *Hypogynous scales* narrowly linear, acute, 1·5 mm long. *Pistil* 17–21 mm long, gently curved, almost 1 mm thick above ovary, gradually narrowed above, glabrous except the ovary which is densely pubescent with ferruginous appressed hairs in upper half; pollen-presenter slightly downcurved, ± 1·5 mm long, slightly kinked at base, narrowed upwards, obtuse, laterally compressed, the lower side with a dark brown narrowly elliptic area which appears stigmatic. *Infructescence* 4–6 cm diam., old flowers long persistent, the style becoming stiff and wiry, remaining brown for some years. *Follicles* up to 35, in plan view broadly linear and usually undulate, 15–20 mm long, 11–15 mm high, 4–6 mm wide; valves semi-circular, thickened downwards but contracted above insertion

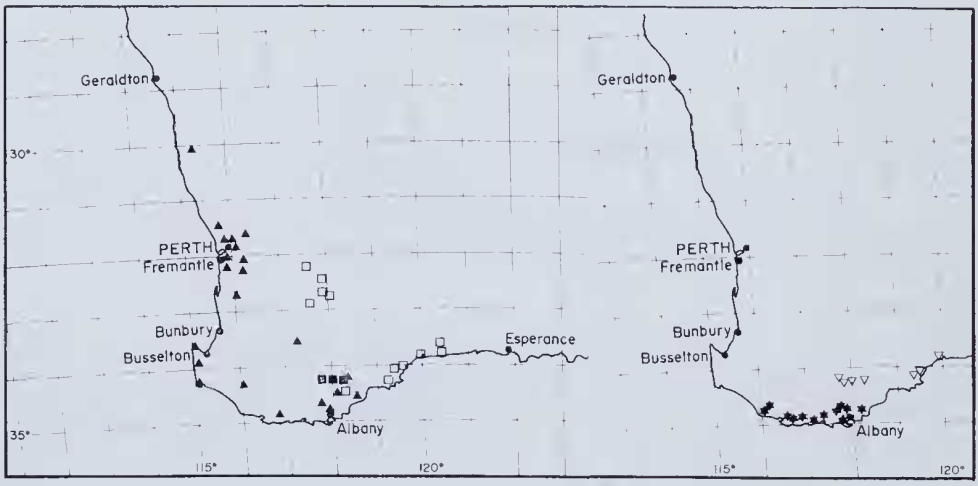


Figure 38. Distribution of *Banksia grandis* (▲), *B. solandri* (■), *B. baueri* (□), *B. quercifolia* (★) and *B. oreophila* (▽).

into bracts, shortly pubescent; suture prominent, slightly rugose; follicles opening with fire, when open 1–2 cm across; valves ± recurved; lips 1–2 mm wide. *Seed* obovate, 20–21 cm long; seed body 8–9 mm long, 5–6 mm wide, ± cuneate, obtuse at base, narrowly winged (± 1 mm) on stylar side, more broadly on the other side; inner face sometimes ridged along centre, black-brown glistening; outer face with short, scattered ridges, ± dull brown; wing not notched, 16–17 mm wide, black-brown and glistening inside, dull brown outside. *Separator* similar to seed in shape but shortly and sharply beaked on stylar side.

Distribution. (Fig. 38) South West Western Australia: near the south coast from Windy Harbour to Cheyne Beach, within 35 km of the coast.

Selected collections. Windy Harbour, 9 Sept. 1971, *S. Paust* 310 (PERTH); Bow River, Dec. 1912, *S. W. Jackson* s.n. (NSW, PERTH); Stirling's Terrace (Albany), 21 Sept. 1840, *L. Preiss* 489 (B, L, MEL); 2 miles (3 km) E of King R. on Albany—Mt. Manypeaks road, 30 July 1953, *R. Melville* 4420 and *R. D. Royce* (AD, CANB, K); 10 miles (16 km) NW of Cheynes Beach, 28 May 1964, *A. S. George* 6302 (PERTH); Narrikup, 29 July 1953, *R. D. Royce* 4241 (PERTH).

Habitat. In peaty sand or grey-white sand in depressions and on swamp margins, in tall shrubland—sedge formation, sometimes in low open woodland of *Eucalyptus marginata* and *Banksia ilicifolia.*

Flowering period. April to July.

Diagnostic features of *B. quercifolia* are the thin leaves with flat, serrate margins, the numerous inflorescences, the ferruginous awned perianths not relaxed after anthesis, the stiff styles and the narrow follicles. The persistent perianths retain their colour for many months after anthesis. When forming, the follicles are bright green, turning brown as they mature.

The species shows no more variation than occurs in most taxa, this being seen in size of leaves, flowers and fruit, and in leaf lobing. Unusual features are the glabrous branchlets, partly glabrous involucral and common bracts, basipetal floral development and the awned perianth which at anthesis separates but does not relax, so that the pollen-presenter remains loosely enclosed by the limb. The inflorescences are produced in some numbers on the older branches and over the years become quite crowded within the shrub. The plants are killed by fire but regeneration from seed is satisfactory provided that two fires do not occur in quick succession. Flowering may begin in 3 years when the plants are as low as 20 cm tall.

Banksia quercifolia is closely related to the following species, *B. oreophila* A. S. George.

Figure 39. *Banksia oreophila.* A—Habit, 2·5 m tall. B—Old flower and fruit. (Both East Mt. Barren W.A.).

13. Banksia oreophila A. S. George, nom. et stat. nov. (Figure 39)

Based on *Banksia quercifolia* R.Br. var. *integrifolia* F. Muell., Fragm. 7:57 (October 1869).

Type citation: "in cacuminibus montium Stirlingi notavi". Lecto (here chosen): MEL, a sheet labelled by Mueller "Banksia quercifolia Br. var. integrifolia" with the annotation "new Tulbinups, Stirling Range, bushy, about 6 ft". The mountain is now known as Toolbrunup.

Derivation of name. From the Greek *orco-*, mountain-, and *philo*, loving, in reference to the usual habitat of the species.

Cotyledons (Fig. 8.11) ovate, with upper margin oblique, 11–12 mm long, 8–10 mm wide, horizontal, flat, dull green with yellow margins, faintly 3-nerved and reticulate; auricles descending, almost acute, 1·5 mm long. *Hypocotyl* stout, 10 mm long, loosely hirsute, dark red. *Seedling leaves:* first 2 immediately above cotyledons, ± obovate, acute, 13–14 mm long, 4–6 mm wide, dentate with 3–5 triangular acute lobes, 1–2 mm long on each side, the sinuses U-shaped; margins slightly recurved; lamina sparsely hirsute above becoming glabrous, hirsute on midrib below and loosely woolly in lacunae; next 2 leaves sub-opposite, higher ones scattered, obovate to narrowly cuneate, obtuse but mucronate, up to 8 cm long, 3 cm wide, dentate with triangular, mucronate teeth 2–4 mm long, slightly oblique; lamina narrowed to base but scarcely petiolate; margins flat; glabrous above except a few hairs along midrib, sparsely hirsute on midrib below, woolly in lacunae, glabrous on lateral venation. *Seedling stem* sparsely hirsute for 1–2 cm, then glabrous.

Mature plant a shrub to 3 m without lignotuber, much-branched. *Bark* thin, smooth or lightly fissured, grey or pale grey-brown. *Branchlets* somewhat angular becoming terete, glabrous, golden-orange or pink, slightly glaucous, sometimes a few linear-subulate prophylls near base, the prophylls glabrous except in axils where pubescent, usually deciduous. *Leaves* scattered or sometimes opposite, cuneate to narrowly obovate, truncate, mucronate, 2–11 cm long, 5–25 mm wide, flat, entire or with a few teeth on upper margins, rarely serrate almost to base, the teeth mucronate, up to 5 mm long; lamina glabrous above and below except a few short appressed hairs on midrib, and fine white wool in lacunae below; lateral nerves at 50°–70° to midrib, not raised, very finely reticulate between; petiole 2 mm long, thick, glabrous. *Inflorescence* cylindrical, 4–5·5 cm diam. at anthesis, on short lateral leafy branchlet, sometimes terminal; development basipetal. *Axis* 2–9 cm long, 3–4 mm wide, 11–12 mm wide with common bracts, without flowers for ± 5 mm at base. *Involucral bracts* few, linear-subulate on thick bases, glabrous except for tomentose bases, persistent to anthesis. *Common bracts* cuneate, 4 mm long, densely hirsute; exserted apex flattened, slightly undulate, obtuse, shortly tomentose at base, otherwise glabrous; sometimes tomentose. *Floral bracts* similar but shorter and slightly narrower, the apex smaller, scarcely glabrous. *Flowers* pale mauve to pink, sometimes pale ferruginous, the limb greyish; styles cream. *Perianth* 20–29 mm long including limb of 3–4 mm and awn of 3–10 mm, curved gently up then downwards; claws 0·5 mm wide, tapering, closely pubescent outside or the hairs somewhat spreading, glabrous inside in lower half, the upper margins pubescent; limb linear to narrowly fusiform, shortly appressed-pubescent, topped by a filiform awn, closely pubescent outside, downturned; perianth splitting but not relaxing at anthesis. *Anthers* 1–1·5 mm long on filaments of 1·5 mm, shortly apiculate. *Hypogynous scales* narrowly linear, obtuse, 1·5 mm long. *Pistil* 15–21 mm long, curved like perianth, slender but rigid, glabrous; pollen-presenter narrower than style, obtuse, laterally compressed, slightly curved with a stigmatic dark area on the inside of the curve, not grooved; ovary shortly pubescent about apex, otherwise glabrous. *Infructescence* moderately stout, 5-6 cm diam.; old perianths and styles long persistent, the latter becoming rigid; involucral bracts persistent. *Follicles* up to 20, rather prominent, in plan view elliptic to broadly oblong, 20–28 mm long, 10–12 mm high, 10–18 mm wide; valves semi-circular to semi-elliptic, much swollen and rounded in upper part, smooth to somewhat rugose, shortly pubescent becoming glabrous where exposed, brown, gold or orange when mature; ridge very broad and round, rarely narrow; suture prominent, impressed; follicles opening with fire, to 10 mm across, not recurved, not beaked. *Seed* broadly obovate, 22–25 mm long; seed body semi-elliptic, oblique, obtuse at base, 10–11 mm long,

6 mm wide, not winged; inner face somewhat convex, thickened on upper side, ± smooth, black-brown, very shining; outer face slightly convex, faintly rugose, brown, slightly mottled; wing 16–18 mm wide, ± even, black-brown. *Separator* similar to seed in shape and size, impressed and ± smooth against seed body, thickened above; wings recurved.

Distribution. (Fig. 38) South West Western Australia: near the south coast, on mountains of the Stirling Range and the Barrens.

Selected collections. Summit of Ross Peak, Stirling Range, 13 Oct. 1902, *A. Morrison* s.n. (PERTH); 4·3 km along Scenic Drive from Red Gum Pass road, Stirling Range, 24 June 1976, *A. S. George* 14281 (PERTH); Hamilla Hill, near Cranbrook, 24 Sept. 1973, *E. C. Nelson*, ANU 17391 (CANB, PERTH); Bluff Knoll, Stirling Range, 29 Oct. 1976, *R. J. Hnatiuk* 761483 (PERTH); Middle Mt. Barren, 16 July 1970, *A. S. George* 10090 (PERTH); East Mt. Barren, no date, *Maxwell* s.n. (K).

Habitat. In rocky or shale soil, usually quartzite or metasandstone, in low heath or tall open-shrubland, mostly on the upper slopes and summits of low mountains.

Flowering period. June to July.

Banksia oreophila is closely related to *B. quercifolia.* It is a more robust plant with coriaceous leaves that are entire or almost so and bluish-green; the flowers are usually mauve-pink, and the follicles are swollen in the upper half giving them a thick, rounded aspect. Its rocky, upland habitat is quite different from the swampy habitat of *quercifolia.* Several collections from the Stirling Range are somewhat intermediate between the two species in having narrower follicles, about 1 cm wide, that are narrowed to the ridge, e.g. George 14281. Occasionally most of the leaves are serrate e.g. Mt. Hassell, A. R. Main (PERTH), but usually they are entire or sparsely dentate.

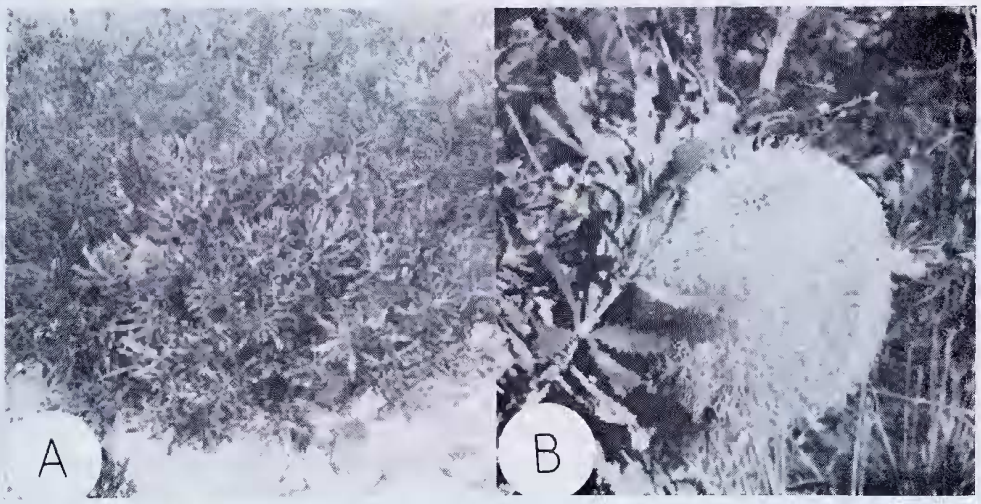


Figure 40. *Banksia baueri.* A—Habit, 70 cm tall (East Mt. Barren, W.A.). B—Inflorescence and leaves (E of Ravensthorpe, W.A.).

14. Banksia baueri R.Br. (Figure 40)

Prot. Nov. 35 (1830)—*Sirmuellera baueri* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid, regio mont., prope King George's Sound, 1829. *D. Baxter.*" Lecto (here chosen): BM, a sheet labelled by Brown "Banksia Baueri Prodr. Flor. Nov. Holl. Suppl. 1 p. 35. Mountains inland from King George's Sound 1829 Mr. Wm. Baxter". Iso: BM (including an infructescence), K.

Cotyledons (Fig. 8.12) obovate, spreading, 18–20 mm long, 9–13 mm wide, faintly 3-nerved, dull green, upper margin slightly crenulate; auricles descending almost vertically, ± acute, 2 mm long. *Hypocotyl* stout, 2–3 cm long, glabrous, deep red. *Seedling leaves*:

first 2 opposite, immediately above cotyledons, narrowly obovate, obtuse, 25–35 mm long, 9–10 mm wide, serrate on each side with 3–4 obtuse lobes 1–3 mm long, margins slightly recurved; lamina above hirsute, hirsute below on midrib otherwise loosely woolly; lamna itapering to petiole ± 1 cm long; upper leaves scattered, progressively more widely spaced (up to 1 cm) and larger, to 15 cm long, 35 mm wide, similar in shape and leaf lobing but with many teeth. *Seedling stem* densely tomentose and hirsute.

Mature plant a shrub without lignotuber, much-branched and bushy, up to 2 m tall, 3 m wide. *Bark* less than 0·5 cm thick, lightly fissured, grey, not friable. *Branchlets* terete, densely tomentose with curled hairs and hirsute with spreading hairs, pale ferruginous becoming grey; glabrous after 2–3 years; subulate tomentose-hirsute prophylls 1–1·5 cm long on lower few cm of branchlet. *Leaves* narrowly obovate, sometimes oblong, obtuse or retuse with a deciduous hirsute-tomentose mucro, 4–13 cm long, 5–35 mm wide, tapering to petiole of 5–10 mm; margins flat to slightly recurved. serrate almost to base, the teeth obtuse to acute, up to 5 mm long, distal side concave; sinuses obliquely U-shaped or almost V-shaped, 2-10 mm wide; lamina ± undulate, closely tomentose and hirsute above, becoming glabrous; hirsute on main nerves below with the lacunae woolly, the midrib tomentose and hirsute, becoming glabrous except the lacunae; petiole hirsute and tomentose; leaves at first pale ferruginous. *Inflorescence* very large, on a short lateral branchlet, sometimes terminal to main branchlet, 12–13 cm diam. at anthesis. *Axis* 7–17 cm long, 10–13 mm wide, 27–30 mm wide with common bracts. *Involucral bracts* numerous, subulate on thick bases, 6–15 mm long, tomentose becoming hirsute towards apices, pale ferruginous; flowers at base of axis usually only partly developed, forming a secondary "involucre". *Common bracts* linear, 9–11 mm long, densely hirsute, the exserted apex conical, slightly upturned, obtuse, tomentose with extreme apex shortly penicillate, brown with pale apex. *Floral bracts* similar but narrow, slightly shorter with a small exserted apex. *Flowers* cream or ferruginous with grey or grey-brown limb, the awns mauve or ferruginous; style cream. *Perianth* 58–65 mm long including limb of 3–4 mm and awn of 15–17 mm; claws filiform, 0·5 mm wide above base; indumentum variable, closely pubescent to loosely hirsute, more densely so on flowers towards apex of inflorescence, glabrous inside; limb fusiform-narrowly oblong, somewhat thickened at base, hirsute with short or long hairs, often wearing off the lower half; awn fine, hirsute outside. *Anthers* 1·5 mm long on filaments of 0·3–0·5 mm, shortly apiculate. *Hypogynous scales* broadly oblong, obtuse to truncate, 1–1·5 mm long. *Pistil* 45–55 mm long, gently down-curved then turned sharply upwards towards apex and geniculate below pollen-presenter which is ± horizontal, glabrous; pollen-presenter 2–4 mm long, narrow, finely 8-ribbed, with a small smooth apical swelling in which the stigmatic groove is lateral; ovary appressed-pubescent about apex. *Infructescence* moderately robust, the follicles concealed for some years among the persistent old perianths and styles; involucral bracts persistent; axis not much enlarged. *Follicles* up to 60, in plan view narrowly elliptic, 22–29 mm long, 12–17 mm high, 8–12 mm wide; valves broadly semi-elliptic, convex, smoothly rugose, densely tomentose; ridge rounded; suture fine; follicles opening usually with fire, to 30 mm, somewhat recurved; valves spilt from stylar point leaving beak; lips 1·5–2·5 mm wide, even. *Seed* obovate, 32–40 mm long; seed body obovate, obtuse at base, 12–15 mm long, 7–8 mm wide, rounded at apex, margins narrowly winged; inner surface ± flat but with narrow flange around upper margin, dark brown, very finely spotted, glistening; outer surface convex, very coarsely pitted with intervening irregular ridges, the pits brown, finely spotted, glistening, the ridges dull grey to creamy-brown; wing 16–23 mm wide, curved to stylar side where deeply split leaving broad secondary lobe. *Separator* similar to seed in shape and size, acute or obtuse at base, flat and thin against seed body thickened with a small overhanging ridge above, a channelled ridge leading to stylar point, laterally beaked but compressed; wings rather thin, strongly and often obliquely recurved.

Distribution. (Fig. 38) South West Western Australia: extending from Kweda and Toolibin south eastwards to Munglinup and the south coast between Bremer Bay and Starvation Boat Harbour; also on the South Stirling plains.

Selected collections. Kweda, Aug. 1929, *R. J. G. Reid* s.n. (PERTH); Jitarning, between Kulin and Harrismith, 31 March 1975, *W. H. Butler* s.n. (PERTH); Tarin Rock, July 1926, *C. A. Gardner* s.n. (PERTH); 30 km along South Stirling road from Albany-Chester Pass road, 10 July 1978, *A. S. George* 15225 (CANB, K, PERTH); Along Rabbit Proof Fence, 25 miles (40 km) S of Jerramungup-Ravensthorpe road, 2 Oct. 1966, *R. Filson* 9127 (MEL); SE side of East Mt. Barren, 1 Oct. 1970, *B. R. Maslin* 955 (NBG, PERTH); 30 miles (48 km) E of Ravensthorpe, 3 Sept. 1968, *E. M. Bennett* 2722 (PERTH).

Habitat. In deep white or grey sand, in shallow sand over laterite or in sand among quartzite rocks, as a component of low shrubland, occasionally in mallee tall open-shrubland.

Flowering period. May to July.

Banksia baueri is a distinctive species easily recognised by the very broad inflorescences; the pubescent to hirsute perianths with long awns; the geniculate style; the infructescences with persistent old perianths and styles; the follicles with lateral beaks when open; and the seeds with the seed body ridged on the upper inside edge and coarsely pitted outside. The broad bushy habit and absence of a lignotuber are also characteristic. Although fairly uniform in most features the species shows some variation in perianth indumentum and colour. The perianth claws vary from closely pubescent to loosely hirsute, but as well the perianths on the upper 1–2 cm of the axis are usually more densely hirsute than those below. The colour varies from mauve-grey to ferruginous, the latter colour being typical of plants on the Barrens but also seen in some populations east of Ravensthorpe and near Kulin. There is no morphological distinction accompanying these colour variants that would justify formal infraspecific division of the species.

The species is often locally common but, being of unremarkable habit and usually bearing its flowers or older stems within the bush, it is not a dominant plant physiognomically. The inflorescence takes 5–6 months to develop.

Banksia baueri is placed in the series *Quercinae* but is anomalous in some features, especially the finely-ribbed pollen-presenter with a stigmatic groove and the presence of a beak in the open follicle. The evenly obovate cotyledons with crenulate upper margins also differ somewhat from those of *B. quercifolia* and *B. oreophila*, perhaps showing a link towards *B. sceptrum* and *B. menziesii* of the *Orthostylis*.

Series **Orthostylis** (Benth.) A. S. George, stat. nov.

Banksia section *Orthostylis* Benth., Fl. Austral. 5:543 (1870).

Type species: **B. serrata** L.f., lecto. nov.

Trees or *shrubs* with or without lignotubers or fire-tolerant stems. *Leaves* shortly serrate or triangular-lobed. *Inflorescence* terminal or on lateral branchlet, ovoid to cylindrical. *Involucral bracts* usually deciduous by anthesis. *Perianth* robust, yellow or cream, sometimes reddish or chocolate, appressed-pubescent to hirsute, sometimes villous. *Pistil* usually curved, sometimes sigmoid below apex; pollen-presenter narrowly fusiform with a small basal swelling, 8-ribbed. *Follicles* usually very large, laterally beaked after opening. *Cotyledons* broadly obovate to cuneate, usually 10–20 mm long.

The *Orthostylis* contains 8 species, 3 in eastern Australia (*B. aemula* R.Br., *B. ornata* F. Mucll. ex Meissner and *B. serrata* L.f.) and 5 in South West Western Australia (*B. baxteri* R.Br., *B. candolleana* Meissner, *B. menziesii* R.Br., *B. sceptrum* Meissner, and *B. speciosa* R.Br.). In southern Australia it is one of two series linking species in the west and east, the other being the *Spicigerae* of the section *Oncostylis*. Although the species of the *Orthostylis* are somewhat heterogeneous, they have enough in common to be grouped together. In particular they share the robust flowers with curved styles, 8-ribbed fusiform pollen-presenters and large follicles. *Banksia aemula* is anomalous in its conical pollen-presenter but in all other respects is clearly a close relative of *B. serrata*. The presence of an indumentum of hairs or papillae on the styles of most species also links the species, since the style is glabrous in all other species of the genus except *B. pilostylis* (series *Cyrtostylis*).

Banksia sceptrum is tentatively placed in this series on account of its robust flowers, hirsute style and prominent pollen-presenter, but in some respects it also shows a relationship to the series *Cyrtostylis*. In particular the smaller follicles and the obovate, crenulate cotyledons are like those of several species of that series.

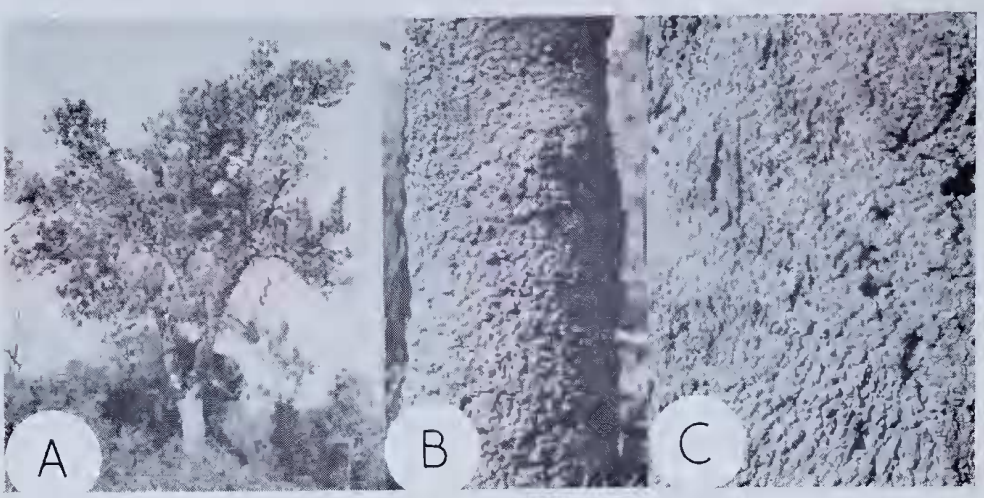


Figure 41. *Banksia serrata*. A—Habit, ± 12 m tall. B and C—Bark. (A and C—Bribie Is., Qld.; B—N of Coffs Harbour, N.S.W.).

15. Banksia serrata L.f. (Figure 41)

Suppl. 126 (Oct. 1781)—*Sirmuellera serrata* (L.f.) Kuntze, Rev. Gen. Pl. 2:582 (1891)—*Isostylis serrata* (L. f.) Britten, Illust. Aust. Pl. Cook. Voy. 3:83 (1905).

Type citation: "*Habitat* in Nova Hollandia. *I. Banks*, Armiger". Lecto (here chosen): BM, a sheet labelled by Banks: "New South Wales Botany Bay. J.B." and by Robert Brown "Banksia serrata Linn. suppl. Botany Bay." The sheet bears a single specimen in late bud. Iso: B, C, NSW.

B. aemula Sieber ex Meissner, in DC. Prod. 14:461 (1856), nomen nudum, non R.Br.

B. conchifera Gaertner, De Fruct. 1:221, t.48, fig. 1 (Dec. 1788). No type was cited, but Gaertner quoted verbatim the diagnosis of *B. serrata* and referred directly to Linnaeus fil. Suppl. 126. The name is therefore superfluous.

B. mitis J. Knight, Prot. 112 (Dec. 1809), nom. illeg., superfl. Type: as for *B. serrata* L.f.

B. media auct. Hook.f., Fl. Tasm. 1:329 (Dec. 1857), non R.Br. (1830).

B. serraefolia J. Knight, Prot. 112 (Dec. 1809), nom. superfl. Knight cited in synonymy both "*B. serrata* Andr." and *B. serratifolia* Salisb. The former should be *B. serrata* L.f. and Andrews' figure is of this species.

B. serrata L. f. var. *hirsuta* R. Baker, Proc. Linn. Soc. N.S. Wales 21:462 (1896). *Type citation:* "Only one clump of this species seen, and that on one of the ranges at Kelgoola". I have not found any collection to correspond with this citation.

B. undulata Lindley, Bot. Reg. tab. 1316 (1830). *Type citation:* Lindley referred to "Mr. Campbell, Gardener to the Comte de Vandes, in whose collection it exists". Lecto (here chosen): CGE, annotated by Lindley "Banksia undulata B. Reg" and "Hort. Comitis de Vandes".

Cotyledons (Fig. 8.13) obovate, somewhat oblique in upper half, ± spreading, faintly 3-nerved, dull green, 10–14 mm long, 10–15 mm wide; auricles descending to spreading, acute, 2 mm long. *Hypocotyl* thick, hirsute, red. *Seedling leaves* broadly linear to oblanceolate, the first 2 opposite, 2–2·5 mm long, later ones 3·5–5 cm and then to 10 cm long; acute, mucronate; margins slightly recurved, deeply lobed almost throughout, over half way to midrib, the lobes triangular, mucronate, distal margins shorter than proximal, up to 3 mm long on first leaves, to 6 mm later; sinuses U- or V-shaped; upper surface of lamina sparsely hirsute chiefly along centre becoming glabrous; lower surface hirsute on nerves, the lacunae woolly. *Seedling stem* hirsute with long, straight hairs and a few short ones.

Mature plant a tree to 16 m, sometimes in coastal habitats a shrub of 1–3 m. *Stem* single. *Bark* up to 3 cm thick, tuberculate-verrucose, somewhat friable, grey-brown. *Branchlets* tomentose and hirsute for 2–3 years. *Leaves* ± crowded at upper end of branchlets, lasting for 2–3 years; broadly oblong to narrowly obovate, truncate but with a short, obtuse, tomentose mucro; petiole 1–2 cm long or shorter in small leaves, lamina (4)7–20(26) cm long, (1)2–4(4·5) cm wide; margins entire for 1–5 cm from base, then serrate with lobes 1–3 cm long, the distal margin concave to gently sigmoid, the proximal slightly convex or concave, the apices slightly upturned, obtuse or almost acute; margins slightly recurved; upper surface at first tomentose with short, curled hairs but soon glabrous and shining; lower surface tomentose with pale ferruginous curled hairs and a few long ones becoming glabrous except the lacunae; petiole closely tomentose. *Inflorescence* terminal to 1 or 2 year old branchlet, subtended by leaves; 9–12 cm wide at anthesis. *Axis* 7–15 cm long, 9–10 mm wide, 20–24 mm wide with common bracts, bearing flowers almost to base. *Involucral bracts* thickened at base, terete above but obtuse, the outer 5 mm long, inner 10 mm, densely ferruginous-tomentose, mostly fallen by anthesis. *Common bracts* broadly linear, widened upwards, 7 mm long, densely hirsute with long, ferruginous hairs, the exserted apex ± conical, upturned, tomentose with short, curled hairs and a few longer, deciduous ones at extreme apex. *Floral bracts* similar but narrower, 6 mm long, the exserted apex conical, short, not upturned. *Flowers* creamy-grey; styles cream. *Perianth* 3·8–4·2 cm long including limb of 7–8 mm, straight but with the limb sharply upturned before anthesis, then relaxed; claws linear, 0·7 mm wide with a central nerve, closely pubescent with short to medium curled or wavy hairs; glabrous inside; limb narrowly fusiform, acute, ± 1 mm wide, densely tomentose outside, a few hairs inside behind anther or glabrous. *Anthers* 3 mm long including apiculum of 0·5 mm. *Hypogynous scales* linear but narrowed upwards, 2 mm long, obtuse to acute, free. *Pistil* 4·7–6 cm long, gently curved down then upwards with the pollen-presenter after anthesis straight, glabrous or papillose towards base; pollen-presenter 2·5–3 mm long with a thickened kink at the base, then fusiform, 8-ribbed with 4 of the ribs more prominent, obtuse; ovary glabrous except for a ring of straight hairs around the apex. *Infructescence* massive, the old flowers persistent with the styles bent down and outwards. *Follicles* up to 30, prominently exserted, broadly elliptic in plan view, 25–35 mm long, 20–25 mm high, 15–22 mm wide, valves slightly excentrically semi-circular without a beak, smooth, closely tomentose with short curled hairs, at length glabrous in exposed areas; suture fine with a slight ridge along each side; follicles opening 15–30 mm wide, a split on each side of the stylar point leaving a beak; lips 2–2·5 mm wide at apex, 2·5–4 mm wide on anti-stylar side. *Seed* obovate, 30–34 mm long; seed body ± obovate, 10–12 mm long, 9–11 mm wide, obtuse at base, the stylar side ± straight, anti-stylar side strongly convex, narrowly bordered; inner surface flat to slightly convex, acutely verrucose, black-brown, slightly glistening; outer surface convex, irregularly and shallowly pitted, especially towards base, dull dark brown; wing 21–25 mm wide, strongly curved to stylar side where prominently notched leaving short, broad secondary wing; anti-stylar side decurrent half-way down seed body; dark brown and dull inside, grey-brown and shining outside. *Separator* similar to seed in shape and size, moderately robust, impressed against seed body, somewhat thickened above especially on stylar side where beaked; wings recurved at apices.

Distribution. (Fig. 43) Queensland, New South Wales, Victoria and Tasmania: from near Cooloola in south east Queensland (26°S), southwards on the coastal plain and some nearby mountains to Wilsons Promontory, Victoria; there is a large population at Sisters Creek in north western Tasmania, but the species is absent from the islands of Bass Strait.

Selected collections. QUEENSLAND: Cooloola, near Noosa; near King's Bore road about 0·4 km E of Teewah Creek, 17 Dec. 1971, *A. G. Harrold* 00190 (BRI); Bribie Island, Easter 1914, *C. T. White* s.n. (BRI). NEW SOUTH WALES: Wahou Trig, 7 miles (11·26 km) NW of Woolgoola, 23 May 1973, *A. G. Floyd* s.n. (NSW); Oakdale-Burragorang Lookout, 5 Sept. 1951, *L. A. S. Johnson* (NSW); "Artillery Hill", Royal National Park, 8 April 1970, *R. Coveny* 2981 (NSW, PERTH, W).

VICTORIA: Walkerville near Waratah Bay, 28 Feb. 1951, *A. Carter* s.n. (MEL); Mt. Leonard, Wilsons Promontory, 10 Nov. 1908, *J. W. Audas & St. John* (MEL); 18 km W of Orbost, Princes Hwy., 13 May 1975, *A. S. George* 13084 (CANB, MEL, PERTH).

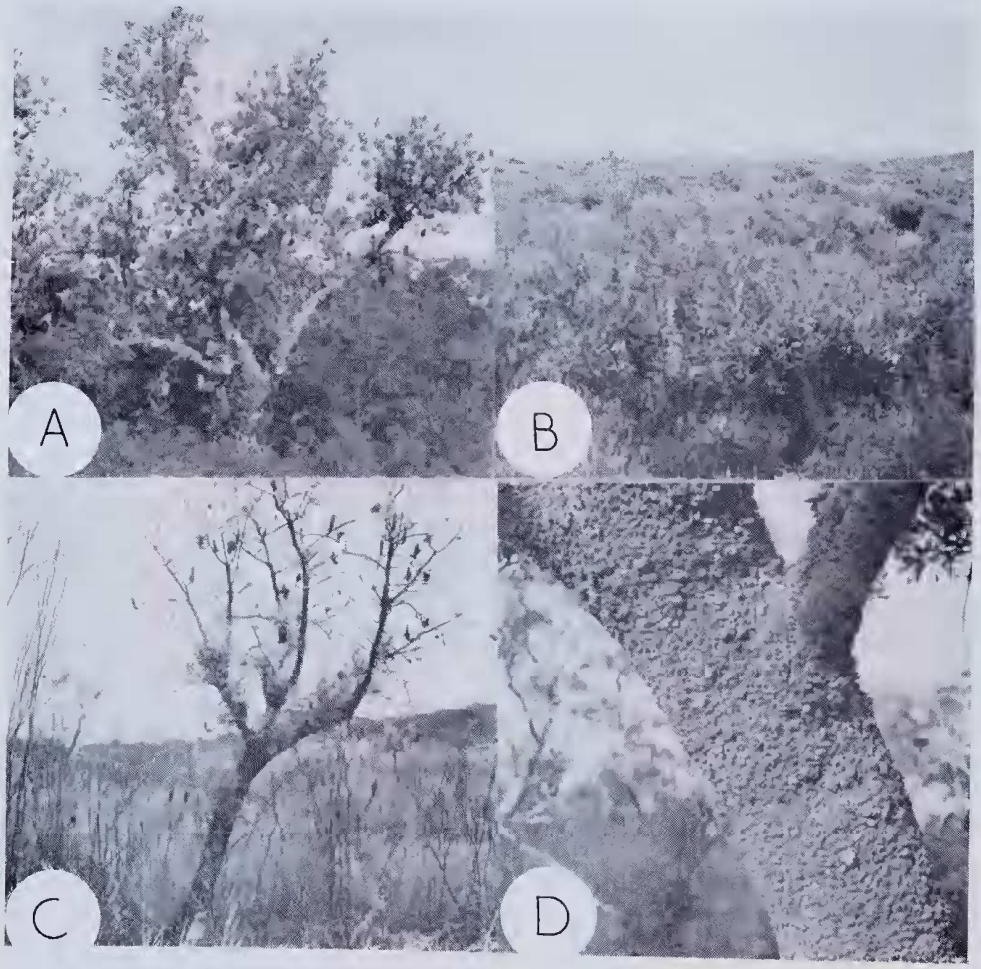
TASMANIA: Rocky Cape, Oct. 1838, *R. C. Gunn* 871 (HO).

Habitat. In deep sand on consolidated dunes near the coast and in shallow sand over sandstone both near the coast and in the Blue Mountains, usually in sclerophyllous woodland; often dominant; sometimes where stunted a component of tall shrubland.

Flowering period. January to June, flowering later in the south than in the north.

Banksia serrata is the lectotype species of the genus (Sprague, 1940). Unlike several other species of wide distribution (e.g. *B. integrifolia*), it is quite uniform throughout its range showing only the normal variation in size of leaves, flowers and fruit. The habit also varies according to habitat, being stunted in exposed coastal situations. Characteristics of the species are the verrucose bark; the serrate leaves ± glabrous on both sides; the large, creamy-grey flowers; the narrow, finely ribbed pollen-presenter, and the massive follicles. The closest relative is *B. aemula* R.Br., of very similar general aspect but differing especially in the short conical, smooth pollen-presenter. *Banksia aemula* usually has a shorter indumentum, narrower leaves, pale yellow (not greyish) flowers, and larger follicles. The two species are occasionally found together, and presumed hybrids have been collected, e.g. Cooper Park, Bellevue Hill, 1948, Johnson (NSW 119973). The pollen-presenter is intermediate in form and size, and slightly ribbed, while the indumentum is short like that of *aemula*.

Less closely related is *B. ornata* F. Muell. ex Meissner, a shrubby species from western Victoria and South Australia with smaller leaves, flowers and fruit; it is fire-sensitive, whereas *B. serrata* and *B. aemula* are fire-tolerant.



16. Banksia aemula R.Br. (Figure 42)

Trans. Linn. Soc. London 10:209 (Feb. 1810).

Type citation: "In Novae Hollandiae orâ orientali: prope Port Jackson: in campis arenosis ericetisque. (ubi v.v.)" Lecto (here chosen): BM, a sheet annotated by Brown "25 Banksia aemula prodr. 395 Banksia serrata Lin. fil. ubique circa Sydney and Parramatta June 1801". Iso: BM, E, K.

B. elatior R.Br., Trans. Linn. Soc. London 10:209 (Feb. 1810). Type citation: "In Novae Hollandiae orâ orientali; prope Sandy Cape: prope littora. (ubi v.v.)" Holo: BM, a sheet annotated by Brown "23 Banksia elatior prodr. 395 Sandy Cape a tall tree".

B. serratifolia auctt. non Salisb. (1796), e.g. Beadle et al. (1972).

Cotyledons (Fig. 8.14) cuneate with upper edges rounded and slightly crenulate, 13–20 mm long, 16–21 mm wide, widely spreading, ± undulate, faintly reticulate, medium dull green; auricles descending-spreading, acute, 2 mm long. *Hypocotyl* thick, hirsute with erect or spreading straight hairs. *Seedling leaves*: first 2 opposite, 3–8 mm above cotyledons, upper ones scattered; oblong to narrowly obovate, at first 3·5–6·5 cm long, then up to 10 cm long, mucronate, serrate over 1/2-way to midrib with triangular lobes 2·5–4 mm long; proximal margin of lobes concave, the distal slightly concave to convex, apex acute to mucronate with a straight or slightly upturned mucro; lamina loosely long-hirsute on both sides but becoming glabrous except for the lower midrib and the woolly lacunae. *Seedling stem* hirsute with spreading hairs.

Mature plant a robust tree to 8 m or a bushy shrub. *Trunk* stout. *Bark* 2–3 cm thick, verrucose, slightly friable. *Branchlets* densely tomentose with short curled hairs and a few long ones, the latter soon wearing off and the indumentum all disappearing after 3–4 years. *Leaves* narrowly obovate to oblong, 3–22 cm long, 0·5–3 cm wide (mostly 1–2 cm wide), narrowed into a petiole 0·5–1·5 cm long, truncate to emarginate with an obtuse tomentose mucro; margins slightly thickened, flat to slightly recurved, serrate throughout with triangular obtuse lobes 1–3 mm long, the distal margin slightly concave, the proximal gently sigmoid; sinuses angular, 45°–90°; lamina at first ferruginous-tomentose to hirsute on both sides, the upper side soon glabrous, the lower indumentum more persistent but later wearing off to leave only the lacunae white-tomentose; leaves persistent for up to 3 years. *Inflorescence* terminal, surrounded by leaves, 8–9 cm wide at anthesis. *Axis* 4–20 cm long (mostly 8–12 cm), 7–10 mm wide, 18–25 wide with common bracts, bearing flowers throughout. *Involucral bracts* linear-subulate, 12–14 mm long, closely tomentose with curled, pale-ferruginous hairs, deciduous before anthesis. *Common bracts* 6–7·5 mm long, oblong but slightly broadened upwards, densely hirsute; exserted apex ± 2 mm long, rhomboid-conical, slightly upturned, obtuse, tomentose, without long hairs, 3-nerved. *Floral bracts* similar but 5·5–7 mm long and narrower; apex short, rounded. *Flowers* pale yellow to greenish cream throughout. *Perianth* 3·5–4·5 cm long including limb of 5 mm, slightly curved, with limb upturned before anthesis; appressed-pubescent outside with short hairs, glabrous inside; limb fusiform, obtuse, 1·5 mm wide, densely pubescent with short curled and longer wavy hairs. *Anthers* 2 mm long with prominent obtuse apiculum. *Hypogynous scales* oblong, obtuse, 3 mm long. *Pistil* 3·5–4·5 cm long, slightly sigmoid, lowest third papillose, upper 2/3 glabrous; pollen-presenter straight or slightly upturned after anthesis, clavate-conical, obtuse, 1 mm long, 0·7 mm wide, obscurely ribbed; ovary glabrous except at apex where shortly hirsute with erect, straight hairs. *Infructescence* massive; old perianths and styles long persistent. *Follicles* up to 25, in plan view elliptic, 3–4·5 cm long, 2–3·5 cm high, 2–3·5 cm wide, ridge obtuse, suture fine; valves semi-circular but offset, densely and closely tomentose with crisped hairs, smoothly rounded; follicles opening to 2·5–4 cm, valves split leaving beak on stylar side; lips evenly 2–3 mm wide, or wider on side opposite stylar point. *Seed* obovate, 40–47 mm long; seed body ± cuneate, 10–15 mm long, 11–16 mm wide; base obtuse; lateral margins straight or slightly convex; upper margin sometimes oblique, curved, a thickened ridge on inside; inner face ± flat, slightly rugose, dark brown to black

Figure 42. *Banksia aemula*. A—Arborescent habit, ± 9 m tall (Bribie Is., Qld.). B—Shrubby habit, 1·5 m tall (S of Byron Bay, N.S.W.). C—Regeneration by epicormic shoots after fire; dead plants of *B. ericifolia* var. *macrantha* below (S of Byron Bay, N.S.W.). D—Bark (NE of Gympie, Qld.).

or slightly mottled, ± glistening; outer face convex, smooth or irregularly ridged and pitted, dark grey-brown; wing 20–32 mm wide, curved to stylar side where deeply cleft leaving a short secondary lobe, ± translucent, shining grey-brown outside, dark brown inside. *Separator* obovate, 32–40 mm long, 22–23 mm wide, moderately robust; base obtuse, impressed by seed body; wings recurved, dull brown outside, paler and shining inside; a short beak at stylar point, with a low ridge down line of notch in seed wing.

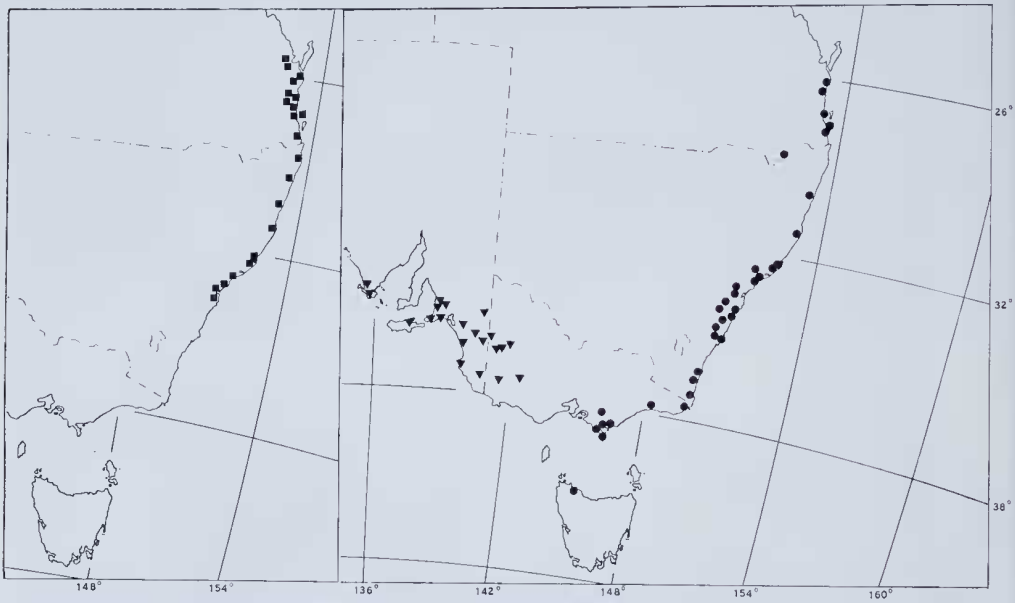


Figure 43. Distribution of *Banksia serrata* (●), *B. aemula* (■), and *B. ornata* (▼).

Distribution. (Fig. 43) Queensland and New South Wales: in near-coastal areas from Bundaberg (25°S) to Sydney (34°S).

Selected collections. QUEENSLAND: Howard, between Maryborough and Bundaberg, 13 Sept. 1930, *Miss Watson* 4058 (BRI); 24 km N of Coolum Beach, about 130 km N. of Brisbane, 31 Jan. 1976, *P. R. Sharpe* 1975 (BRI); 4 miles (6 km) S of Pt. Lookout, Stradbroke Is., 17 March 1968, *G. Trapnell* s.n.(BRI). NEW SOUTH WALES: Coffs Harbour, June 1911, *J. L. Boorman* (NSW); 8 km E of Raymond Terrace, 1 May 1975, *A. S. George* 13034 (CANB, NSW, PERTH); Mouth of Clarence River, 1880, *Fawcett* (MEL); Botany Swamps near Botany Bay, 20 March 1957, *L. L. Wilson* 465 (NSW).

Habitat. Commonly on consolidated sand dunes especially near the coast, as a component of either sclerophyllous low woodland or tall shrubland (called "Wallum" in Qucensland); also in swales and on sandy flats, the latter sometimes seasonally waterlogged, and in sand over sandstone.

Flowering period. Mainly March to June, but sometimes at other seasons.

As with *Banksia asplenifolia* Salisb., so with *Banksia serratifolia* Salisb. (1796) there has been much discussion as to the application of the name. The name *B. aemula* R.Br. was used throughout the 19th century, except by O. Kuntze who took up *serratifolia* in combination with *Sirmuellera* (which nobody followed). In 1921, Domin used *serratifolia*, and the epithet was later used in New South Wales, e.g. Beadle, Carolin and Evans (1972). Blake (1959), having looked into the matter (notes at BRI), stated that "this identification is uncertain and Domin's action should not be followed"; nor has it been in Queensland, e.g. Lebler (1972). The protologue of *B. serratifolia* was brief and described only the leaves:

> "5. B. foliorum laminis rectis, lineari-lanceolatis, profunde serratis, truncatis cum mucrone, adultis utrinque glabris, planis.
> B. serrata *Linn. Suppl.* p. 126. diversissima species est.
> Ex *Port Jackson* auct. Jac. Lee."

The description could apply to *B. aemula* R.Br., *B. serrata* L.f. or *B. paludosa* R.Br. The last is unlikely, since it usually has leaf margins that are only a little dentate and somewhat revolute, but juvenile foliage is more dentate. No contemporary sheets annotated as *B. serratifolia* have been found, excepting one at LINN. This is labelled "New South Wales Mr. White, 1791" in Smith's hand and is a small branchlet with juvenile leaves; it is either *B. serrata* or *B. aemula*. In mature foliage these two species can usually be easily distinguished, but in juvenile leaf there are no consistent characters to separate them. There is no indication that Salisbury saw this collection. His comment that *B. serrata* is a very distinct species has led to the conclusion that *B. serratifolia* is the plant named by Brown as *B. aemula*. Brown himself included *serratifolia* as a synonym but with a question mark, indicating his uncertainty as to the application of the name. Because of variation in the leaves of *Banksia* species, especially between seedling, juvenile and mature leaves, there was considerable confusion in the early nomenclature. The same species in several cases was given a number of epithets. In the absence of firm evidence as to the application of the name *Banksia serratifolia* Salisb., I therefore consider it a nomen dubium and use the next valid name, *B. aemula* R.Br., for the taxon to which Salisbury's name has sometimes been applied. In fact it is more likely that the name *serratifolia* refers to *serrata* L.f. since in Knight's "On the Cultivation of the Plants belonging to the Natural Order of Proteeae" (1809), the name *serraefolia* is used with, in synonymy, "B. serrata, Andr. in Bot. Rep. n. 82, cum le. B. serratifolia, Salisb. Prodr. p. 51." It is probable that Salisbury wrote much of the text of Knight's work (Britten, 1886, Stearn, 1960), and the plate in Andrews Botanist's Repository is of *B. serrata* L.f.

Banksia aemula is very closely related to *B. serrata* L.f. but may easily be distinguished by the club-shaped pollen-presenter. Less obvious differences are the bark which is usually more verrucose in *aemula*, the short indumentum of the branchlets, the usually narrower leaves, the pale lemon-yellow flowers (greyish-cream in *serrata*) and the larger follicles and seeds. The perianth limb of *B. aemula* is wider below the middle, while that of *B. serrata* is evenly fusiform. Several presumed hybrids between the two have been recorded (see *B. serrata*).

Banksia aemula is fire-tolerant, sprouting by epicormic shoots after a burn. It sets prolific fruit, however, with follicles that may open spontaneously when mature or remain closed until burnt. Seedlings are often seen, though few reach maturity.

Figure 44. *Banksia ornata*. A—Habit, 1·8 m tall (S of Meningie, S.A.). B—Bark (Marble Ra., S.A.)

17. Banksia ornata F. Muell. ex Meissner (Figure 44)

Linnaea 24:352 (Aug. 1854)—*Sirmuellera ornata* (F. Muell. ex Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Versus Villnugam et in fruticetis montium Marble-ranges, Febr." Lecto (here chosen): MEL—labelled, in Mueller's hand, "Banksia ornata Fer. v. M11. Versus Villnugam 1 Febr. 51" (MEL 52587). Syn: MEL, labelled "Banksia ornata Fer. v. M11. Ad basis montem Marble-ranges in fruticetis. Febr. 52" (MEL 52586).

B. ornata F. Muell. ex Meissner var. *rufa* E. Ashby, Express and Journal (Adelaide), 27 July 1935, nom. illeg. (without Latin description).

Cotyledons (Fig. 8.15) cuneate with upper angles slightly rounded, ± 8 mm long, 10–11 mm wide, ± recurved, faintly reticulate, medium green, upper margin convex; auricles ± vertically descending, acute, 1·5 mm long. *Hypocotyl* short, ± stout, glabrous, pinkish green; seed coat often retained as "collar" about hypocotyl. *Seedling* leaves: first 2 or 4 opposite, close above cotyledons, narrowly obovate, 15–25 mm long, 5–8 mm wide, obtuse, sometimes mucronate; margins somewhat recurved, serrate with 2–4 triangular acute or obtuse lobes 1–2 mm long, the sinuses obliquely U- or V-shaped; upper surface and lower surface on midrib and nerves hirsute with spreading white hairs; lacunae of lower surface loosely white-woolly; petiole winged, hirsute; upper leaves crowded; increasing in size up to 12 cm long and 3 cm wide, narrowly obovate, truncate or emarginate with short mucro; margins slightly revolute, serrate with somewhat oblique, acute, triangular teeth up to 3 mm long, sinuses usually V-shaped; upper surface hirsute with long spreading hairs and often with curled ones along midrib, becoming glabrous; lower surface hirsute and pubescent with straight and curled hairs on midrib and nerves, somewhat persistent; lacunae small, white-woolly. *Seedling stem* densely hirsute.

Mature plant a shrub to 3 m tall without lignotuber, much-branched, bushy. *Stem* up to 10 cm diam. *Bark* 2–4 mm thick, finely fissured, not friable, grey. *Branchlets* slightly ribbed, densely hirsute to pubescent with short curled and long hairs, pale to deep ferruginous, becoming glabrous after 2–3 years; a few thick, linear, tomentose bracts near base. *Leaves* narrowly obovate to obovate-cuneate, obtuse to truncate, shortly mucronate, 3–11 cm long, 4–25 mm wide, tapering to short petiole; margins flat to slightly recurved, serrate except near base, the teeth triangular, acute or obtuse 1–3 mm long, sinuses U- or V-shaped; upper surface hirsute and pubescent with long and short pale ferruginous hairs (more dense along midrib) becoming glabrous; lower surface similar on nerves, the lacunae loosely woolly; lateral nerves at 60°–70° to midrib, finely reticulate between. *Inflorescence* on short lateral branchlet usually ± within shrub, occasionally terminal to main branchlet, ± broadly cylindrical, 7–8(9) cm diam. at anthesis. *Axis* 5–8(11) cm long, 5–6 mm wide, 19–22 mm wide with common bracts. *Involucral bracts* linear-subulate on short thick bases, 5–10 mm long, densely pubescent to hirsute, the outer ones grey, inner ferruginous, mostly deciduous before anthesis. *Common bracts* linear to narrowly cuneate, 7–8 mm long, densely hirsute, the exserted apex ± depressed-conical, upturned, obtuse, closely pubescent with pale brown curled hairs and a few long hairs. *Floral bracts* similar but narrower and shorter with small hirsute apices. *Flowers* cream with greyish-cream limb, sometimes pale ferruginous; style cream with deep pink pollen-presenter. *Perianth* 30–35 mm long including limb of 3–4 mm, ± straight with limb upturned before anthesis; claws filiform, 3–4 mm wide, shortly hirsute outside, glabrous inside; limb narrowly elliptic, almost acute, densely hirsute with both short, curled and long hairs. *Anthers* 2·5 mm long on short filaments, shortly apiculate. *Hypogynous scales* narrowly oblong-ovate, obtuse or irregularly lobed, ± 1·5 mm long. *Pistil* 35–38 mm long, almost straight but curved upwards in upper 1/3, slightly geniculate below pollen-presenter, often sparsely appressed-pubescent for a few mm about ovary, glabrous above; pollen-presenter narrowly ovoid, obtuse, 1·5–2 mm long, finely ribbed; stigmatic groove oblique; ovary appressed-hirsute about apex. *Infructescence* of moderate size, cylindrical-ovoid; old perianths and styles long-persistent. *Follicles* up to 50, in plan view elliptic, 15–20(30) mm long, 4–8 mm high, 10–15 mm wide; valves semi-elliptic, convex, ± smooth, densely tomentose-hirsute, grey; ridge rounded, suture very fine; follicles usually opening only with fire, up to 20 mm across, recurved, split near stylar

point leaving a beak; lips 1–2 mm wide, becoming broader on anti-stylar side. *Seed* obovate, 21–25 mm long; seed body cuneate, ± acute at base, 8–11 mm long, 10–11 mm wide; lateral margins straight to slightly convex, narrowly winged; anti-stylar angle rounded; inner face ± flat, smooth, deep brown, slightly glistening; outer face irregularly pitted and rugose, dark to pale brown with cream bands, the pits dark brown; wing 13–15 mm wide, curved to stylar side where deeply notched leaving small secondary lobe, dark brown and dull inside, paler and somewhat shining outside. *Separator* similar to seed in shape and size, moderately robust, flat against seed body, a thick overhanging transverse ridge above, with a thick beak to stylar point; wings recurved.

Distribution. (Fig. 43) South Australia and Victoria: in S.A., southern Eyre Peninsula, Kangaroo Island and the south-east between Adelaide, Pinnaroo and Mt. Gambier; in Vic., the far central west, chiefly in the Big and Little Deserts as well as in the Grampians and near Casterton.

Selected collections. SOUTH AUSTRALIA: S end of Marble Ra., Eyre Peninsula, 24 May 1975, *A. S. George* 13116 (AD, BRI, CANB, MEL, NSW, PERTH); 5 miles (8 km) from American River, Kangaroo Is., 25 Sept. 1965, *M. E. Phillips* 020985 (NSW); Mt. Lofty Ra., Ashbourne, 4 April 1926, *E. H. Ising* s.n. (AD); Dark Island, 10 miles (16 km) NE of Keith, 14 Aug. 1952, *R. Melville* 438 & *R. L. Specht* (K, MEL).

VICTORIA: Round Lake Nature Trail, Wyperfeld National Park, 20 Oct. 1969, *B. G. Briggs* 2867 (NSW); Little Desert, Lowan, 12 Dec. 1887, *F. M. Reader* (MEL); Black Range, W of the Grampians, 5 March 1948, *J. H. Willis* s.n. (MEL).

Habitat. Usually in deep sand with heath, mallee shrubland or sometimes low woodland; sometimes in rocky (quartzite) sandy loam.

Flowering period. Mainly winter and spring, but flowers have been recorded in most months.

Banksia ornata is a distinctive species of the series *Orthostylis* characterised by its shrubby, non-lignotuberous habit, and small leaves, flowers and fruit. In these details it differs from its near-relative *B. serrata* L.f. It is one of only two species of *Banksia* in South Australia and, while geographically isolated from other members of the series, lies between those of the South West and those of the east coast. There is little morphological variation, but the flower colour varies from cream to ferruginous.

18. Banksia menziesii R.Br.

Prot. Nov. 36 (1830)—*Sirmuellera menziesii* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora merid.-occid., ad rip. Swan River, 1827. D. Fraser." Lecto (here chosen): BM, labelled by Brown "Banksia Menziesii R.Br. Banksia No. 23 Fraser Swan River, A tree, Fraser, recd. May 1828 from Mr. Maclcay". Iso: K, labelled "Swan River Mr. Chas Fraser 1827" with tag "No. 23" attached; BM, fruiting specimens in carpological collection.

Cotyledons (Fig. 8.16) broadly obovate, 10–14 mm long, 10–15 mm wide, spreading, crenulate along upper margin, faintly nerved in lower half, ± bright green with fine red margin; auricles vertically descending, obtuse, 1 mm long. *Hypocotyl* short, thick, glabrous, green. *Seedling leaves* crowded above cotyledons; first 2 ± lanceolate, acute, 3–4 cm long, 9–12 mm wide, divided 3/4 way to midrib into obliquely triangular obtuse or acute lobes 2–4 mm long; sinuses V-shaped; margins slightly recurved; upper surface of lamina hirsute with straight and curled hairs; lower surface hirsute on midrib, the lamina densely woolly; higher leaves becoming more widely spaced, up to 10 cm long, 16 mm wide with lobes up to 6 mm long; upper surface sparsely pubescent, indumentum otherwise as in first leaves. *Seedling stem* densely hirsute and tomentose.

Mature plant a tree to 10 m or a shrub to 3 m, the latter usually with several stems arising from a lignotuber. *Trunk* stout; bark 2–3 cm thick, verrucose, friable, greyish pink or pale brown. *Branchlets* somewhat striate, closely and densely pubescent, pale brown, then grey, becoming glabrous after 2–3 years; several linear-terete, obtuse, densely tomentose prophylls near base of branchlet, soon deciduous. *Leaves* oblong, truncate but shortly mucronate, slightly narrowed towards apex and tapering to petiole, 8–25 cm long, 1–4 cm wide, dull green; margins flat to slightly recurved, dentate throughout with

triangular teeth 1–2 mm long, the teeth obtuse to acute, regular to slightly oblique; sinuses shallow, U-shaped, 2–9 mm wide; upper surface of lamina densely and closely tomentose with short curled hairs interspersed with a few long ones especially along midrib, becoming glabrous; lower surface hirsute and tomentose on midrib, the lamina closely woolly, becoming glabrous except lacunae; indumentum pale brown except the white wool of the lacunae; petiole 8–17 mm long, closely tomentose. *Inflorescence* broadly ovoid-cylindrical, terminating branchlet of recent growing season, rarely older, conspicuous, 7–8 cm diam. at anthesis. *Axis* 4–12 cm long, 6–8 mm wide, 15–22 mm wide with common bracts, without flowers in basal 5–10 mm. *Involucral bracts* linear-terete on ± thick bases, mostly 5–13 mm long, the outer thicker than the inner, densely tomentose-villous, pale brown, mostly deciduous before anthesis. *Common bracts* cuneate, 5–7 mm long, densely hirsute with deep ferruginous hairs; exserted apex transversely conical, obtuse, slightly upturned, densely tomentose with a few longer hairs also, whitish to pale brown. *Floral bracts* similar but slightly shorter, narrower, with small rounded exserted apex, indumentum as in common bracts. *Flowers* usually pale to deep pink or red with silvery indumentum, becoming pale to cream towards base; sometimes pale yellow, chocolate or ferruginous throughout; style similar but often more deeply coloured in upper half. *Perianth* 29–38 mm long including limb of 5–6 mm, ± straight with limb upturned before anthesis; claws 0·5 mm wide tapering upwards, appressed-pubescent outside, glabrous inside; limb linear, almost acute, appressed-pubescent to hirsute with a few longer hairs at apex. *Anthers* 2 mm long on filaments of almost 1 mm, shortly apiculate. *Hypogynous scales* linear to narrowly obovate, obtuse, 1·5 mm long, free. *Pistil* 37–41 mm long, straight then bowed upwards in upper third, stiff and wiry, glabrous but minutely papillose in upper half, with a narrow quadrangular neck below pollen-presenter; latter narrowly fusiform, slightly swollen at base, 2–2·5 mm long, 8-ribbed, obtuse; stigmatic groove oblique; ovary shortly hirsute about apex, otherwise glabrous. *Infructescence* robust, the common bracts thickened, together with floral bracts forming prominent spiral patterns; old perianths and styles soon deciduous. *Follicles* up to 25, prominently exserted, in plan view narrowly obovate with the stylar side thickened then contracted to a beak; 25–35 mm long, 10–15 mm high, 10–15 mm wide; valves broadly semi-elliptic but curved to stylar side, convex, smooth, very closely pubescent with curled hairs, mottled dark brown and grey; ridge obtuse; follicles usually opening when mature, to 30 mm across; valves recurved, split from stylar point leaving a prominent beak; lips 1·5–3 mm wide, broadening slightly to anti-stylar side. *Seed* ± obovate, 23–30 mm long; seed body obovate, obtuse at base, 10–11 mm long, 11–14 mm wide, lateral margins narrowly winged; inner face ± flat muricate with flattened erect processes, dull black, slightly glistening; outer surface somewhat convex, irregularly pitted around margins, ± reticulate, pale grey-brown; wing 20–25 mm wide, curved to stylar side where notched, black inside, grey-brown outside. *Separator* obovate, similar to seed in size, ± obtuse at base, flat against seed body, with shallow pit-markings, thickened above but not or slightly overhanging, with a thick beak to stylar point; wings robust, recurved.

Distribution. (Fig. 45) South West Western Australia; near the west coast from the Murchison River to Pinjarra, mostly within 50 km of the coast, but ESE of Perth extending to 125 km inland.

Selected collections. Yuna, Sept. 1930, *E. Ashby* s.n. (ADW); Murchison R., no date, *A. Oldfield* s.n. (MEL); Swan River, 1839, *J. Drummond* s.n. (CGE, OXF); NE of Lake Indoon, 9 March 1974, *A. S. George* 11781 (PERTH); Bushmead, Sept. 1963, *R. A. Saffrey* 88 (MEL, PERTH); 17 km due NE of Brookton, between Jurakine Pool and Yenyening Lakes, 31 Aug. 1979, *R. J. Hnatiuk* 790124 (PERTH); Kings Park, July 1924, *C. A. Gardner* 995 (PERTH).

Habitat. In deep white, grey or yellow sand, sometimes with laterite or limestone at depth; when arborescent as a component of low woodland often associated with *B. attenuata* R.Br., *B. ilicifolia* R.Br., *Eucalyptus marginata* Donn ex Sm. and *E. todtiana* F. Muell.; occasionally associated with *Xylomelum angustifolium* Kippist; when frutescent, in mixed open-heath, tall shrubland and low shrubland.

Flowering period. February to August; a few flowers sometimes in late January and in September.

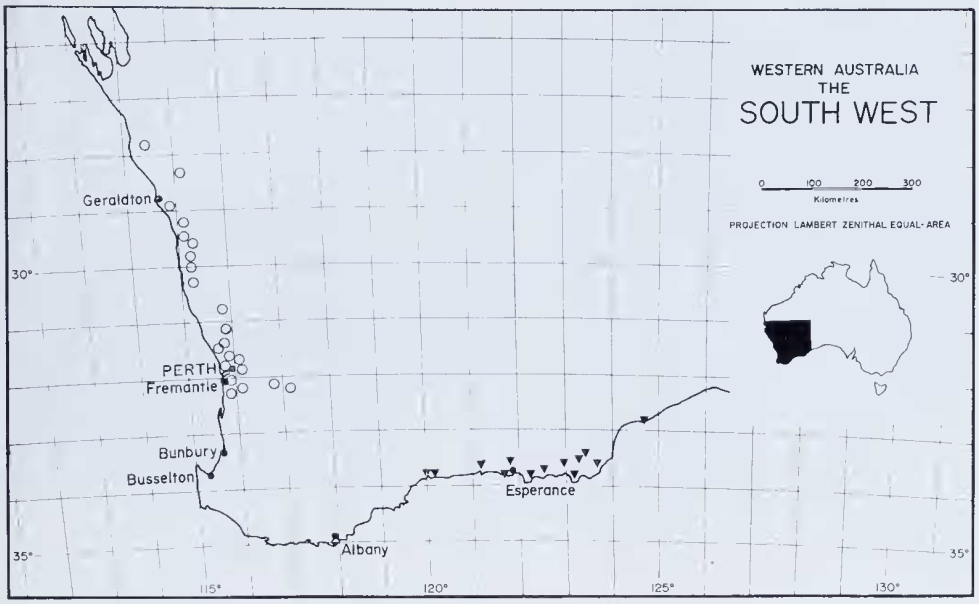


Figure 45. Distribution of *B. menziesii* (○) and *B. speciosa* (▼).

Banksia menziesii, like all members of the series *Orthostylis*, is a clearly defined species. Its characteristics are the arborescent or frutescent habit tolerant of fire; the oblong shortly dentate, dull-green leaves; prominent inflorescences with pink to dull red (sometimes yellow or brown) flowers having a prominent vertical arrangement in late bud; silky perianths; a glabrous and papillose style; prominent mottled follicles which usually open when mature, the old flowers deciduous very early. The species is variable in habit, being a tree in the southern part of its range—south of the Hill River—while in the northern part it is usually a shrub. There is no clear-cut division, however, in either form or distribution. Both variants respond to fire from either epicormic shoots or a lignotuber. Other morphological variation is quite typical of the genus, and no formal division is warranted. Colour variants are more numerous in *B. menziesii* than in any other species. The typical pink is itself variable from pale to deep shades, and occasionally plants are seen with pale yellow, chocolate or ferruginous flowers. The species produces its new growth in late spring, before the initiation of buds.

The closest relatives of *B. menziesii* are probably *B. baxteri* R.Br. and *B. speciosa* R.Br., both species from the south coast of Western Australia. The only members of the *Orthostylis* sympatric with *B. menziesii* are *B. candolleana* Meissner and *B. sceptrum* Meissner. *Banksia menziesii* is probably the main link with species of the series in eastern Australia, especially through *B. serrata* L.f.

19. Banksia speciosa R.Br. (Figure 46)

Trans. Linn. Soc. London 10:210 (Feb. 1810)—*Sirmuellera speciosa* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: in saxosis prope littora. (ubi v.v.)". Lecto (here chosen): BM, annotated by Brown "28 Banksia speciosa prodr. 396. Lucky Bay South Coast Jany 1802". Iso: BM, K, NSW. There is a young fruit in the carpological collection at BM.

Cotyledons (Fig. 8.17) broadly obovate, spreading, 12–13 mm long, 14–15 mm wide, thick, faintly 3-nerved in lower half, ± reticulate above, dull green; auricles spreading, obtuse, 2 mm long. *Hypocotyl* thick, glabrous, red. *Seedling leaves:* first two opposite,

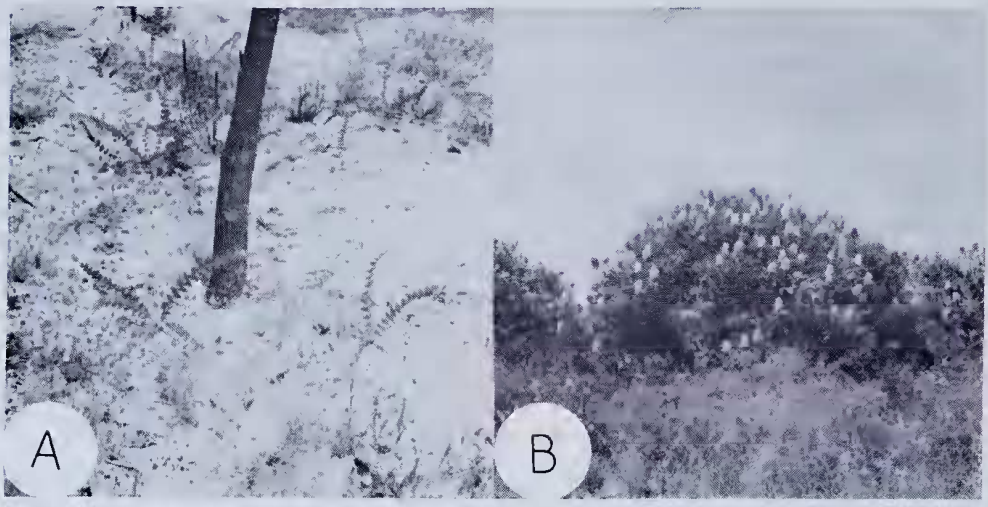


Figure 46. *Banksia speciosa*. A—Dead stem of burnt plant, with seedlings (Esperance, W.A.). B—Habit, 4 m tall (W of Esperance, W.A.).

immediately above cotyledons, ± oblong-elliptic in outline but divided almost to midrib with 3 lobes on each side, the lobes ± obliquely triangular, mucronate, the distal side the shorter and convex, 3–5 mm long, proximal side concave, apex acute, sinus angular, margins slightly recurved; upper surface loosely hirsute becoming glabrous; lower surface white-tomentose, the midrib also hirsute; next 2 leaves sub-opposite, 10–13 cm long, then scattered and 20–25 cm long. *Seedling stem* closely tomentose with white hairs, with a few longer ones which soon wear off.

Mature plant a shrub, without lignotuber, single-stemmed at base, widely branched above, usually up to 6 m tall, sometimes to 8 m. *Bark* ± smooth, grey. *Branchlets* stout, velutinous with brown hairs. *Leaves* scattered, broadly linear, 20–45 cm long, 2–4 cm wide, truncate with an obtuse mucro, divided to midrib into 20–42 lobes, rarely with adjacent lobes united but sometimes overlapping at base; lobes ± triangular, alternate or opposite, margins convex with the distil slightly shorter than the proximal, mostly 1–2 cm long but smaller towards base and apex of lamina where 1–5 mm long, 1–2·5 cm wide at midrib; margin recurved; each lobe with 3–10 nerves converging towards apex, reticulate between; nerves not evident on upper surface; petiole 0·5–1 cm long, flattened above, densely tomentose; lamina densely tomentose above with curled hairs and hirsute with longer straight ones, becoming glabrous; white-villous below, remaining white-tomentose when mature; midrib below prominently raised, at first pubescent with white curled hairs and loosely hirsute with long brown hairs, when mature closely pubescent. *Inflorescence* terminal, conspicuous, on 1–2 year old branchlet, sometimes with younger branchlets below, ovoid, 9–10 cm wide at anthesis. *Axis* 4–12 cm long, 7–9 mm wide, 19–22 mm wide with common bracts, bearing flowers except at extreme apex. *Involucral bracts* numerous in early bud but mostly deciduous before anthesis, subulate from thick, curved bases, 1·5–2 cm long, densely velutinous, the upper half also plumose with ± straight ferruginous hairs. *Common bracts* broadly linear, 8 mm long, densely hirsute, the exserted apex ± rounded, densely tomentose, extreme apex obtuse with a tuft of short white hairs. *Floral bracts* similar but narrower. *Perianth* in bud greyish cream, in flower cream to pale yellow; style cream; pollen-presenter with maroon apex. *Perianth* at maturity 40–45 mm long, including limb of 5–6 mm, ± straight and ascending slightly, the limb upturned before anthesis; claws ± 1 mm wide above base, gradually narrowed upwards, with a prominent central nerve and a close lesser one each side; ± hirsute outside

and densely so just below limb, inside glabrous; limb narrowly oblong-fusiform, almost acute, thick, outside densely hirsute, inside glabrous. *Anthers* ± 3 mm long, apiculate; filament ± 1 mm long. *Hypogynous scales* ± oblong, 2 mm long, apex rounded. *Pistil* 4–5 cm long, gently curved with a small kink at base of pollen-presenter, ± 1 mm thick above ovary, gradually tapering upwards, appressed-hirsute throughout; pollen-presenter 4–5 mm long, 0·5 mm thick, slightly kinked at middle, the lower half ± quadrangular, upper half costate; stigmatic groove transverse just below apex; ovary glabrous except for hirsute apex. *Infructescence* = ovoid; perianths and styles persistent, gradually wearing away. *Follicles* up to 20, elliptic in plan view, massive, prominently exserted, 3·5–5 cm long, 2–3 cm wide, 2–3 cm high: valves semi-elliptic, slightly oblique, ± smooth, thickened along suture, obtuse, densely velutinous, red-brown turning grey, the indumentum wearing off exposed parts; suture fine; follicles opening usually with fire, 2·5–6 cm across when open; valves ± recurved, split on each side of stylar point leaving a lateral beak; lips 5–10 mm wide. *Seed* 3·7–4·5 cm long: seed body broadly obovate-cuneate, 10–14 mm long: 9–12 mm wide, outer surface smooth, grey, inner surface covered with erect filiform or flattened processes up to 2 mm long: wing annular around seed body and 2–4 mm wide, the upper part obovate to broadly oblong, slightly broadened upwards, curved, with a wide notch on the stylar side, 1·2–2 cm wide, grey outside, black-brown inside. *Separator* ± obovate, base obtuse, wings rounded, curved towards stylar side; part beside seed body thin, lightly pitted; a broad beak on stylar side; wings slightly wrinkled on outer side and dark brown, smooth and shining inside where light brown, the whole 2–2·5 cm wide, 3·7–4·5 cm long.

Distribution. (Fig. 45). South West Western Australia: near the south coast from East Mt. Barren to Israelite Bay, mostly within 50 km of the coast; the most inland occurrence is at Mt. Ragged.

Selected collection. Hopetoun, Nov. 1909, *J. H. Maiden* s.n. (NSW, PERTH); West side of Young River on Ravensthorpe-Esperance road, 25 Sept. 1968, *P. G. Wilson* 7836 (PERTH); SW of Mt. Ragged, 24 Oct. 1963, *T. E. H. Aplin* 2586a (PERTH); 6·6 miles (11 km) W of Israelite Bay "settlement", 9 Dec. 1960, *A. S. George* 2137 (PERTH).

Habitat. Usually in deep white or grey sand; often the dominant species in tall shrubland, or mixed with other shrubs such as *Lambertia inermis.*

Flowering period. Flowers have been recorded throughout the year; the peak flowering is in summer and autumn.

Banksia speciosa is a conspicuous element of deep sands—usually consolidated dunes—near the eastern south coast of Western Australia. Its distinctive features are the absence of a lignotuber, the widely branched habit, the long leaves with many triangular lobes, the large conspicuous cream inflorescences, the pubescent styles and the massive follicles with wide lips. Its nearest relative is probably *B. baxteri* R.Br. with which it is sympatric at the western end of its range. That species differs in its smaller, openly branched habit, its shorter, broader leaves with larger, flat lobes, its smaller yellow inflorescences, and somewhat smaller follicles; it has a more definite flowering period, chiefly summer and autumn.

Variation in *B. speciosa* is relatively little, being mainly in the size of leaves, inflorescences and follicles. It is a vigorous species of recent sandy habitats and may be a late development in the *Orthostylis.*

I do not regard *Banksea speciosa* Koenig (1783) as an earlier homonym of *Banksia speciosa* R.Br. It was incorrectly altered to *Banksia speciosa* Koenig by Dietrich in 1802 when making the combination *Costus speciosus* (Koenig) Dietr.

20. Banksia baxteri R.Br.

Prot. Nov. 36 (1830)—*Sirmuellera baxteri* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid., regio mont. prope King George's Sound, 1829, D. Baxter." Lecto: BM, a sheet labelled by Brown "Banksia Baxteri Prodr. supplt. 1 p. 36. King George's Sound Mountains inland 1829 Mr. Wm. Baxter." Iso: K, NSW.

B. speciosa Lindley, Bot. Reg. t. 1728 (1835), non R.Br. (1810).

Cotyledons (Fig. 8.18) cuneate with upper margin oblique, widely spreading, 12–13 mm long, 17–18 mm wide, flat, faintly reticulate, dull medium green; auricles descending-recurved, ± acute, ± 2 mm long. *Hypocotyl* stout, glabrous, green. *Seedling leaves* not recorded.

Mature plant a shrub to 4 m without lignotuber, openly branched. *Bark* lightly fissured, usually with lenticels, greenish brown then grey-brown, 3–5 mm thick. *Branchlets* 5–8 mm thick, at first hirsute and tomentose with long spreading and short curled white hairs, becoming glabrous within 6 months, bright green; usually 1–5 cm at base bearing linear, villous prophylls 1–2 cm long, soon deciduous. *Leaves* scattered, stiff, cuneate in outline, 7–17 cm long, 2·5–7·5 cm wide, truncate with midrib produced into ± soft deciduous hirsute mucro; lamina flat, each side divided to midrib or almost so into 5–10 triangular acute lobes, opposite or alternate, not imbricate, up to 35 mm wide across base, the margins straight or convex; lobes slightly oblique; sinuses V-shaped; lamina densely tomentose above with short curled hairs and hirsute on midrib, becoming glabrous; lower surface with the midrib loosely hirsute with white hairs and densely pubescent with short, curled, pale ferruginous hairs becoming glabrous and yellow, lamina densely pubescent on nerves, the main ones pale brown becoming glabrous, the lacunae white-woolly; petiole remaining hirsute. *Inflorescence* terminal to a recent branchlet, conspicuous, sometimes with several new branchlets immediately below, broadly ovoid, 7·5–8·6 cm diam. at anthesis. *Axis* 3–4 cm long, 6–7 mm wide, 21–23 mm wide with common bracts. *Involucral bracts* openly arranged, linear-subulate on thick bases, 2–3·5 cm long, densely hirsute-villous, ferruginous; many deciduous before anthesis. *Common bracts* narrowly cuneate, ± 8 mm long, densely hirsute; exserted apex conical, obtuse, slightly upturned, densely tomentose, also with scattered long hairs, ferruginous with extreme apex paler. *Floral bracts* linear, 7– 8mm long, the apex small, indumentum as in common bracts. *Flowers* pale lemon-yellow, the claws in upper flowers often pale pink; styles creamy yellow. *Perianth* 39–43 mm long including limb of 9–11 mm, gently curved upwards with limb upturned at anthesis; claws ± 0·5 mm wide tapering upwards, densely hirsute outside with long and short hairs, glabrous inside; limb narrowly fusiform, acute, densely hirsute outside. *Anthers* ± 2 mm long on filaments ± 1 mm long, apiculate. *Hypogynous scales* linear, obtuse, 1·5 mm long. *Pistil* 42–49 mm long, strongly curved upwards, ± 1 mm thick above ovary, tapering upwards, pubescent above ovary, densely hirsute in middle third becoming pubescent upwards, glabrous and quadrangular just below pollen-presenter; pollen-presenter 3–4 mm long, slightly swollen above base then tapering, apex slightly swollen, obtuse; stigmatic groove oblique, open; ovary densely appressed-hirsute at apex, otherwise glabrous. *Infructescence* squat, of up to 6 follicles, rarely more, the old perianths and styles becoming stiff, persistent for several years, eventually wearing away. *Follicles* large, elliptic in plan view, 35–42 mm long, 17–22 mm high, 15–20 mm wide; valves semi-elliptic with prominent beak to stylar point, very convex then narrowed to sutural ridge, smooth, densely velutinous-hirsute, the hairs at first red-brown, becoming grey, persisting for some years; ridge narrow; suture very fine; follicles usually opening only with fire, to 25 mm wide, somewhat recurved, deeply split from stylar point leaving prominent lateral beak; lips 1·5–2 mm wide on stylar side widening to 4–5 mm on opposite side. *Seed* obovate, 30–32 mm long; seed body ± broadly obovate, 12–14 mm long, 11–13 mm wide, obtuse at base, winged on lateral margins; inner face gently convex, covered with irregular filiform or flat processes 1–3 mm long, black-brown, slightly glistening; outer face flat, ± smooth, brown, shining; wing curved to stylar side 27–29 mm wide, split from stylar point leaving short lateral lobe, dark brown inside, grey-brown outside. *Separator* stout, broadly obovate, 29–30 mm long, 27–30 mm wide, rounded at base, impressed and undulate against seed body, thickened above but without overhanging ridge, thickly beaked to stylar point; wings recurved in upper third.

Distribution. (Fig. 47) South West Western Australia: near the south coast from the Stirling Range and South Stirling east to the Oldfield River.

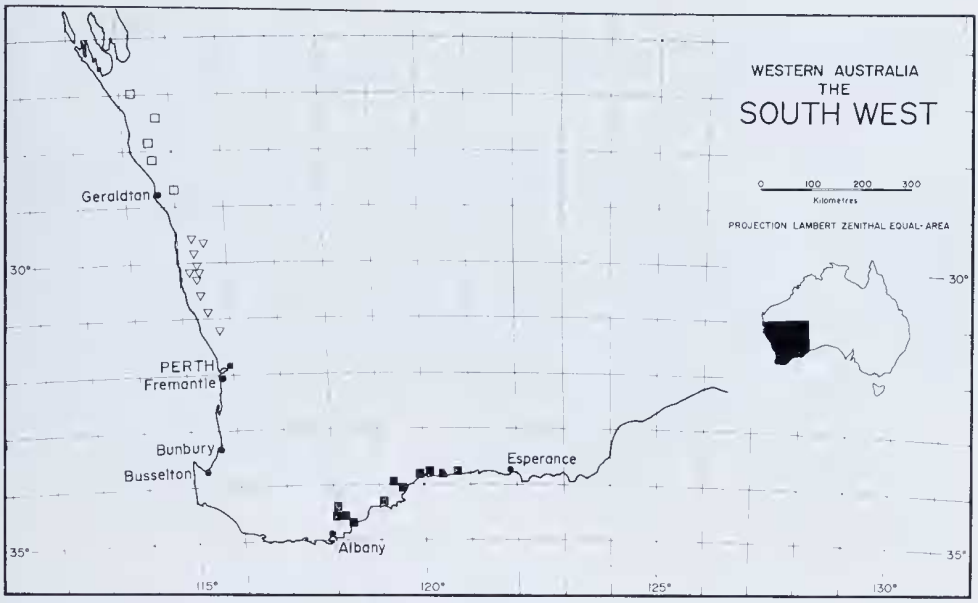


Figure 47. Distribution of *B. baxteri* (■), *B. candolleana* (▽), and *B. sceptrum* (□).

Selected collections. Kalgan Plains, N of river, Dec. 1909, *J. H. Maiden* s.n. (NSW, PERTH); Cheyne Beach, E of Albany, 14 Jan. 1959, *R. Young* (PERTH); Bremer Bay road, 15 miles (24 km) W of Bremer Bay, 1 Oct. 1966, *R. Filson* 9122 (MEL); ca. 14 km east of the mouth of the Oldfield River, 12 Oct. 1968, *Hj. Eichler* 20215 (AD, PERTH).

Habitat. In deep white or grey sand, on plains or consolidated dunes, usually as a component of tall shrubland; sometimes the dominant species.

Flowering period. December to May, the peak from January to March; a few flowers sometimes as late as July.

Banksia baxteri is a distinctive species and very uniform throughout its range, variation being mainly in the size and number of leaf lobes. It is characterised by the non-lignotuberous, openly-branched habit; the stiff leaves with large flat triangular lobes; hirsute and tomentose branchlets soon becoming glabrous; short inflorescences; hirsute perianth; stiff, hirsute styles; infructescences with persistent old flowers; large, beaked, velutinous follicles; and seeds with echinate inner faces. In these characters it differs from its closest relative, *B. speciosa* R.Br. The two are sympatric only from East Mt. Barren to the Oldfield River. Less closely related is *B. menziesii* R.Br. which is a fire-tolerant tree or shrub with verrucose bark, grey-green shortly dentate leaves, inflorescences 5–12 cm long, silky reddish pink (rarely yellow or chocolate) perianths, glabrous styles, infructescences with the old flowers deciduous and follicles that open when mature. *Banksia menziesii* has a very different distribution, occurring near the west coast between the Murchison River and Pinjarra.

21. Banksia candolleana Meissner (Figure 48)

Hook. Journ. Bot. 7:118 (1855)—*Sirmuellera candolleana* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Drummond, coll. vi. n. 201." Lecto: NY, a sheet annotated by Meissner. Iso: B, BM, CGE (2 sheets), E, FI, K, (3 sheets), LD, MEL (2 sheets), NSW, P, U.

Cotyledons (Fig. 8.19) transversely obovate, spreading, 9–10 mm long, 17–18 mm wide, upper margin somewhat irregular, ± nerveless; bright green with reddish margins; auricles spreading, thick, obtuse, 2–3 mm long. *Hypocotyl* short, thick, pale pink. *Seedling leaves*: not recorded.

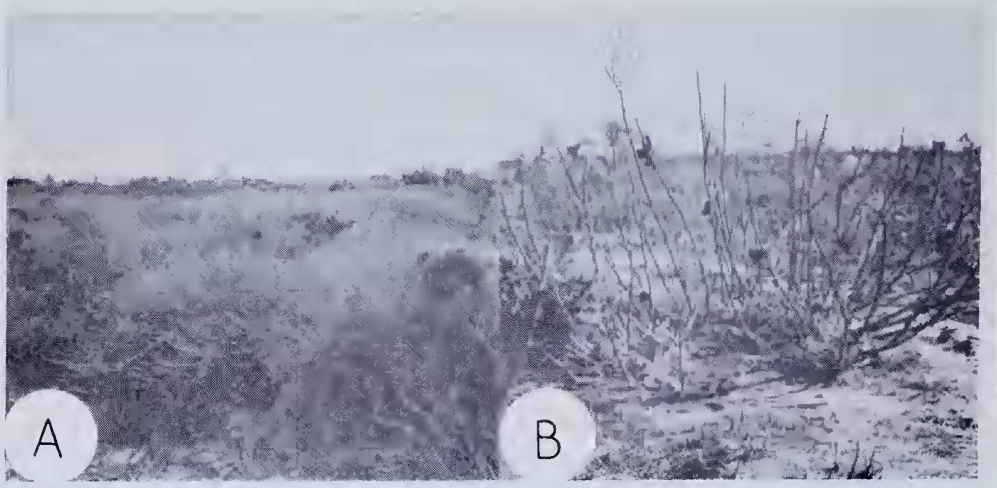


Figure 48. *Banksia candolleana*. A—Habit. B—Regeneration from lignotuber after fire. (Both S of Badgingarra, W.A.).

Mature plant a shrub with a broad lignotuber, up to 2·5 m diam., with many little-branched stems to 1·3 m tall. *Branchlets* smooth or finely striate, 2–4 cm diam., closely tomentose with short, curled hairs becoming glabrous after 1–2 years, pinkish-brown; a few linear, tomentose bracts at base of branchlet. *Leaves* linear, truncate, obtusely mucronate, 15–40 cm long, 6–20 mm wide, ± erect, divided to midrib or almost so into up to 40 triangular lobes, sometimes imbricate at base; lobes rigid, acute to obtuse, with flat or slightly recurved margins, the latter gently sigmoid, rarely with a small secondary lobe on upper margin, up to 15 mm wide across base, lobes towards petiole very short and broad; upper surface of lamina closely tomentose with short, curled white hairs; lower surface tomentose on midrib with pale brown hairs becoming glabrous and yellow, lamina tomentose on nerves becoming glabrous with white wool in the lacunae; lateral nerves 3–4 per lobe converging to apex, finely but prominently reticulate between; petiole 1–2 cm long, closely tomentose. *Inflorescence* on short lateral branchlet with or without leaves, usually from lower stems over 3 years old, often among inflorescences of previous years, broadly ovoid, 5·5–7·5 cm diam. at anthesis. *Axis* 1·5–4 cm long, 3–5 mm wide, 12–18 mm wide with common bracts. *Involucral bracts* terete, obtuse, 2–5 mm long, closely tomentose with curled hairs, pale grey-brown, mostly deciduous before anthesis. *Common bracts* narrowly cuneate, 4–6·5 mm long, densely hirsute; exserted apex rounded, straight or slightly upturned, densely tomentose with curled hairs, pale brown. *Floral bracts* similar but slightly shorter and narrower. *Flowers* yellow to golden, styles pale yellow. *Perianth* 20–27 mm long including limb of 3·5 mm; claws filiform, 0·4–0·5 mm wide tapering upwards, glabrous outside at base, appressed-pubescent above, glabrous inside; limb narrowly elliptic, obtuse, glabrous or sometimes pubescent at apex, prominently 3-nerved. *Anthers* 2 mm long on filaments of ± 0·75 mm, shortly apiculate. *Hypogynous scales* oblong, truncate or retuse, 1–1·5 mm long, cohering in lower half to perianth. *Pistil* 25–35 mm long, curved gently down then up, geniculate below pollen-presenter, appressed-pubescent in lower third, sometimes sparsely, glabrous above; pollen-presenter 2–2·5 mm long, narrowly ovoid with a swelling near base and quadrangular below, obtuse, 8-ribbed; stigmatic groove slightly oblique; ovary pubescent around apex, otherwise glabrous. *Infructescence* squat, of 1–15 follicles, usually up to 5; old perianths and styles long-persistent. *Follicles* prominent, curved to stylar side where obtusely beaked, 2–6·5 cm long, 2·5–5 cm tall, 17–35 mm wide; valves ± obliquely obovate, convex, smooth, or slightly undulate, very closely tomentose, mottled grey and brown; ridge narrow but obtuse; suture fine; follicles opening with fire, to 6 cm across, valves often recurved, deeply split from stylar point leaving broad, obtuse beak; lips 2–5 mm wide. *Seed* 3–6 cm long; seed body broadly obovate, obtuse at base, 10–12 mm long,

12–17 mm wide, lateral margins straight to convex, narrowly winged; upper margin convex, irregular, much raised on inside; inner face ± flat, irregular rugose with thin acute plates, black, slightly glistening; outer face convex, irregularly rugose, grey-brown; wing 30–50 mm wide, curved to stylar side where split leaving obtuse secondary lobe, wrinkled in lower half, black sometimes with brown blotches inside, grey-brown outside. *Separator* similar to seed in outline but smaller, robust, flat and ± rugose against seed body, thickened with an overhanging ridge above, very thickly beaked to stylar point; wings much recurved.

Distribution. (Fig. 47) South West Western Australia: near the west coast, between the Arrowsmith River and Gingin, not more than 50 km inland.

Selected collections. 22 miles (35 km) SW of Three Springs, 30 Aug. 1965, *K. Newbey* 2266 (PERTH); Near Arrowsmith River, 28 June 1970, *A. M. Ashby* 3266 (AD, CANB, FI, L, MEL); Between Green Range and Cockleshell Gully, 20 Aug. 1949, *C. A. Gardner* 9347 (PERTH); ± 11 miles (17 km) N of Gingin, 10 June 1966, *A. S. George* 7763 (PERTH).

Habitat. In deep white, grey or brown sand, or in sand overlying laterite, in low heath, sometimes in tall open-shrubland; often locally common.

Flowering period. April to July.

Banksia candolleana is a well-defined species characterised by the broad, many-stemmed low habit, long leaves with many small triangular lobes, small golden-yellow inflorescences, pubescent flowers with glabrous (or almost so) limbs, and very large, curved follicles among persistent old flowers. At the upper end of the range of size the follicles are the largest in the genus. Many inflorescences set no fruit, and those that do often have only two or three follicles.

The species seems most closely related to *B. speciosa* R.Br. and *B. baxteri*, both much larger shrubs without lignotubers and with larger flowers. The form of the style is similar in all three, and in each it has an indumentum. The leaf lobes of *B. candolleana* are shaped like those of *B. speciosa* but are smaller and flatter with a texture like the much larger lobes of *B. baxteri*. The species is geographically isolated from the south coastal *B. speciosa* and *B. baxteri*. The very close indumentum of *B. candolleana* is unusual in the genus since, except for the few species glabrous or almost so from the beginning, most have long hairs mixed with short ones.

22. Banksia sceptrum Meissner (Figure 49)

Hook. Journ. Bot. & Kew Gard. Misc. 7:120 (1855)—*Sirmuellera sceptrum* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "*Drummond*, coll. vi. n. 206". Lecto: BM; iso: CGE, FI, K (3 sheets), LD, MEL (4 sheets), NSW, NY, P, U. The material at NY is fragmentary.

Cotyledons (Fig. 8.20) obovate, 14–15 mm long, 12 mm wide, recurved, 3-nerved at base, reticulate above, the upper margin crenulate; auricles descending, obtuse, 2 mm long. *Seedling leaves* not recorded.

Mature plant a shrub to 5 m tall and 4 m wide, without a lignotuber, much-branched and usually bushy. *Trunk* stout; bark smooth or slightly tessellated, pale grey. *Branchlets* closely tomentose with curled hairs, pale greenish brown, becoming grey and glabrous after ± 2 years; basal 2–7 cm with linear, deciduous prophylls ± 1 cm long, acute, tomentose with hirsute apices, brown. *Leaves* scattered, oblong, truncate to emarginate but shortly mucronate, 4–9 cm long, 1–3 cm wide, abruptly narrowed to petiole 5–8 mm long; lamina flat or ± undulate, stiff; margins flat, dentate throughout, the teeth shallow-triangular, to 1·5 mm long, obtuse; sinuses very shallow, broadly U-shaped: upper surface densely tomentose with curled hairs, the midrib also hirsute, becoming glabrous; lower surface similar but with a few long hairs also on lateral nerves, and white wool in the lacunae, becoming glabrous except the last: petiole tomentose and loosely hirsute, remaining closely pubescent; terminal mucro plumose when young. *Inflorescence* conspicuous on a recent branchlet, usually without lateral branchlets below, 8–10 cm wide at anthesis. *Axis* 7–21 cm long, 8–10 mm wide, 25–28 mm wide with common bracts.

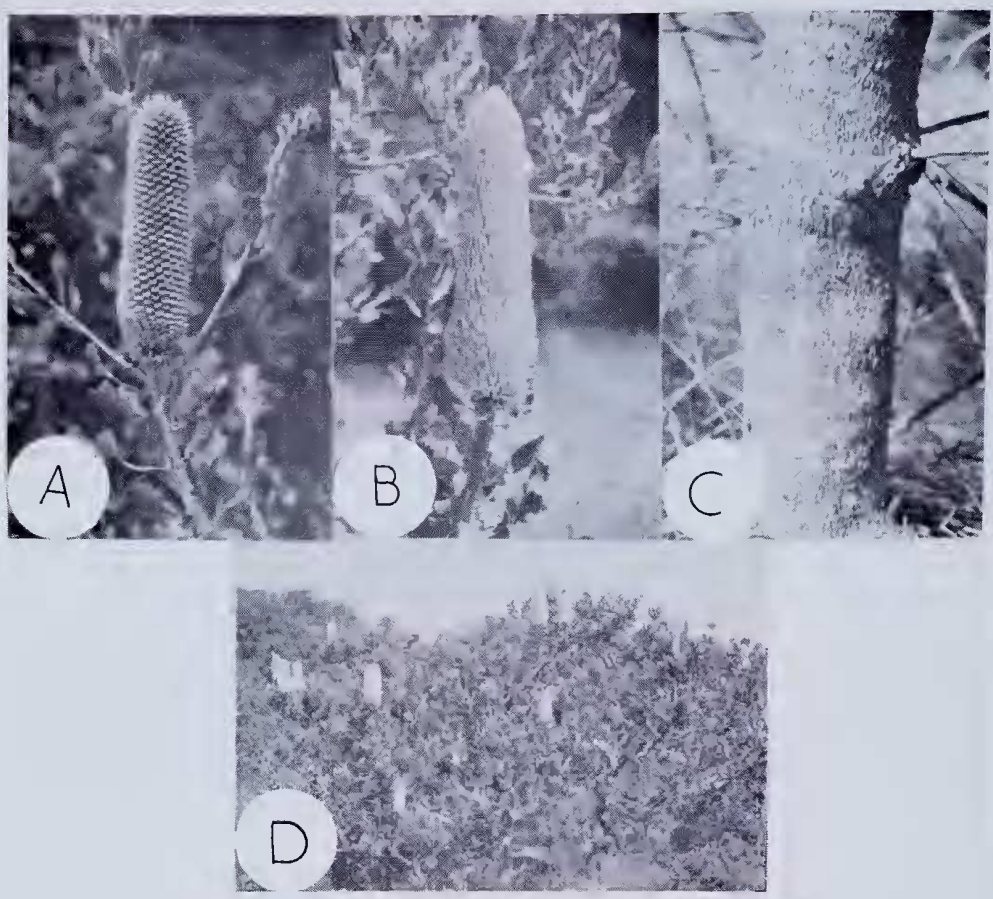


Figure 49. *Banksia sceptrum*. A and B—Developing inflorescence, showing changes in curvature of buds (Both cultivated, Perth). C—Bark. D—Habit, 2·5 m tall (Both N of Northampton, W.A.).

Involucral bracts numerous, subulate-terete, bases somewhat thickened, the outer 5–10 mm long, tomentose, grey-brown, the inner 10–20 mm long, densely hirsute, brown, mostly deciduous before anthesis. *Common bracts* ± cuneate, 9–10 mm long, densely hirsute, deep ferruginous; exserted apex conical but contracted, obtuse, slightly upturned, densely tomentose with pale brown curled hairs, extreme apex penicillate. *Floral bracts* narrowly cuneate; exserted apex conical, short, tomentose, brown. *Flowers* yellow including styles. *Perianth* 28–32 mm long including limb of 6–8 mm; at anthesis straight in lower 1/3 then curved strongly upwards; claws 6–7 mm wide, thick, densely hirsute outside, glabrous inside, nerveless; limb narrowly elliptic, obtuse, thick, appressed-pubescent outside, hirsute at apex. *Anthers* 2·5 mm long on filaments of ± 1 mm, shortly apiculate. *Hypogynous scales* linear, obtuse, 4–5 mm long, adhering to perianth. *Pistil* 40–50 mm long, 45–53 mm straightened, for 2/3 gently downcurved, then abruptly upturned through 90°–110°, then curved outwards, i.e. sigmoid; lower half sparsely and very shortly pubescent, otherwise glabrous; narrowed and quadrangular below pollen-presenter; pollen-presenter 3·5–4 mm long, fusiform with basal swelling, obtuse, obtusely 8-ribbed; stigmatic groove terminal; ovary shortly pubescent about apex, otherwise glabrous. *Infructescence* fairly massive, 6–8 cm diam.; old perianths and styles persistent. *Follicles* up to 50, in plan view broadly elliptic, 15–25 mm long, 8–18 mm high (often half-buried in old flowers), 10–16 mm wide; valves ± semi-orbicular with short lateral beak at stylar point, convex, smooth, mottled dark brown and grey, densely pubescent with curled hairs

and hirsute with spreading hairs, the latter wearing off exposed parts; follicles opening usually with fire, to 30 mm across, recurved, deeply split on each side from stylar point leaving a prominent lateral beak; lips ± 1·5 mm wide, ± even. *Seed* obovate, 30–35 mm long; seed body ± obovate, obtuse at base, 11–14 mm long, 7–9 mm wide, upper margin oblique and produced to stylar point, lateral margins winged, turned inwards; inner face slightly convex, muricate with flattened processes, black-brown, slightly glistening; outer face convex especially on stylar side, very slightly rugose, brown, shining; wing 17–20 mm wide, cleft to stylar point leaving small lateral lobe, a little expanded above, black-brown inside with grey frosting in upper half, dark grey-brown outside. *Separator* similar to seed in shape and size, flat against seed body, very shallowly pitted, obtuse at base, somewhat thickened above, more so on stylar side where narrowly beaked to stylar point; wings somewhat recurved.

Distribution. (Fig. 47) South West Western Australia: near the west coast between Hamelin Pool and Geraldton.

Selected collections. Murchison R., no date, *Oldfield* (MEL); ca. 12 km WSW of Cooloomia homestead, in 26°58′S, 114°12′E, 18 Sept. 1979, *S. D. Hopper* 1342 (PERTH); 12 miles (20 km) N of Northampton on road to Chilominey, 1 Jan. 1972, *A. S. George* 11217 (CANB, MEL); E of Geraldton, 20 Dec. 1962, *F. Lullfitz* 1993 (PERTH).

Habitat. In deep yellow or pale red sand on plains, dunes and in swales, as a component of tall open shrubland.

Flowering period. December and January.

Banksia sceptrum is easily recognised by its large bushy habit, its smooth grey bark, its short, oblong, truncate leaves, its large inflorescences with prominent sigmoid styles and its massive infructescences with persistent old flowers. The hypogynous scales, 4–5 mm long, are the largest of the genus. The muricate inner face of the seed body is also unusual, occurring in only three other species, *B. speciosa*, *B. baxteri* and *B. burdettii*.

The species is often locally common and in full flower can be spectacular since the inflorescences are prominent on the branch apices. The flowering period is relatively short. Development of the inflorescence takes 6 to 7 months, longer than in any other species. The individual inflorescence opens fully in 1 to 2 weeks. The plants, having no lignotuber, are killed by fire and regenerate from seed, reaching flowering in 3 to 5 years.

I have placed *B. sceptrum* in the series *Orthostylis* because of its robust inflorescence and flowers, pubescent style, large, fusiform pollen-presenter and the seeds. The follicle has a similar form to that of *B. ornata*, and the muricate seed body has a counterpart in *B. speciosa* and *B. baxteri*. An anomalous feature, however, is the obovate, crenulate cotyledons which link the species to the *Cyrtostylis*.

Series **Crocinae** A. S. George, series nova.

Frutices vel arbores sine lignotuberis. *Folia* dentata vel lobata lobis triangularibus. *Inflorescentiae* terminales, late cylindricae, conspicuae. *Bracteae involucrales* tomentosae vel villosae, deciduae vel persistentes. *Perianthium* intus crocinum, extus albo-villosum. *Pistillum* leviter curvatum, crocinum; pollinis praebitor angustus cum tumore exiguo centrali, parum costatus. *Folliculi* parvi vel mediocres, rotundati, tomentosi, post dehiscentia lateraliter rostrati.

Shrubs or trees without lignotubers. *Leaves* dentate or lobed with triangular lobes. *Inflorescence* terminal, broadly cylindrical, conspicuous. *Involucral bracts* tomentose or villous, deciduous or persistent. *Perianth* bright orange inside, white-villous outside. *Pistil* gently curved, bright orange; pollen-presenter narrow with a small central swelling, slightly ribbed. *Follicles* of small or medium size, rounded, tomentose, with lateral beak after opening.

Type species: **Banksia prionotes** Lindley

Derivation of name: from the Latin *crocinus*, rich orange, in reference to the inner surface of the perianth and the styles which together give the inflorescences their colour.

The *Crocinae* contains four species endemic near the west coast of the South West Botanical Province, viz. *B. prionotes* Lindley, *B. victoriae* Meissner, *B. hookerana* Meissner and *B. burdettii* E. G. Baker. They are remarkably similar especially in floral morphology,

the specific distinctions being on the basis of indumentum, leaf morphology, follicle size and persistence or not of the old perianths. The species are vigorous colonisers of areas of recent sand, though only *B. prionotes* is widespread.

The series is probably derived from the *Orthostylis*. It is somewhat similar in the pollen-presenter, the robust pistil and the rounded, tomentose follicles. The leaf form of *B. burdettii* is very like that of *B. menziesii*, while that of *B. victoriae* is like *B. baxteri* in form (but not in number and size of the lobes or in indumentum). In foliage *B. victoriae* also shows a link to *B. ashbyi* of the series *Cyrtostylis*.

23. Banksia prionotes Lindley

Sketch Veg. Swan Riv. Col. 34 (Jan. 1840)—*Sirmuellera prionotes* (Lindley) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: none given. Most of the material described in this work was collected by James Drummond. As lectotype of *B. prionotes* I have selected a sheet at CGE labelled "Swan River, Drummond, 1839" and annotated by Lindley "Banksia prionotes m".

Cotyledons (Fig. 8.21) broadly obovate but apex offset, ± convex, 6–10 mm long, 7–8 mm wide, faintly 3-nerved, bright green; auricles horizontal, obtuse, 1 mm long. *Hypocotyl* ± 5 mm long, 1 mm diam., glabrous, the seed coat retained as a collar. *Seedling leaves:* first 2 immediately above cotyledons, narrowly obovate in outline, 15–17 mm long, 7–8 mm wide, obtuse, deeply divided each side into 2–3 narrowly triangular obtuse lobes; margins recurved; sinuses V-shaped; lamina loosely hirsute above, hirsute on midrib below with the lamina loosely woolly; narrowed to base; next leaves crowded, successively larger, the lobes becoming broader, 5 mm across base by the 8th leaf; lower surface of lamina densely woolly; petioles hirsute. *Seedling stem* villous.

Mature plant a shrub or tree to 10 m, without lignotuber, the main branches spreading or erect. *Bark* less than 1 cm thick, ± smooth or horizontally grooved, slightly friable, pale grey. *Branchlets* closely tomentose with curled hairs; prophylls along lower part of branchlet linear-terete, ± obtuse, 5–13 mm long, often incurved at apex, densely hirsute-tomentose, soon deciduous. *Leaves* broadly linear, obtuse to retuse, 15–27 cm long, 1–2 (rarely 3) cm wide, flat to undulate, dentate throughout; teeth triangular, obtuse but rigid, 1–4(5) mm long, 5–10(15) mm wide across base, smaller towards petiole, margins straight or curved especially towards teeth apices, sinuses shallow U- to V-shaped; margins flat; lamina above densely tomentose-hirsute with ± curled hairs, white to pale brown, becoming glabrous; midrib and reticulum hirsute below with spreading somewhat curled deciduous pale brown hairs, lacunae tomentose with curled persistent white hairs; secondary nerves fine, reticulate between; apex when young with obtuse, densely hirsute mucro; petiole densely tomentose above, hirsute below, when old closely grey-tomentose. *Inflorescence* terminal, conspicuous on branchlet usually less than a year old, sometimes the lateral branchlets growing out just before or during flowering. *Involucral bracts* linear-terete from broad bases, 5–10 mm long, densely hirsute-tomentose, persistent to young fruit. *Axis* 7–15 mm long, 6–7 mm wide, tapering to apex, 20–24 mm wide with common bracts, bearing flowers throughout except a few mm at base. *Common bracts* ± fusiform, 9–10 mm long, densely ferruginous-hirsute; exserted apex triangular, obtuse, 2–3 mm long, hirsute with long hairs and white-tomentose. *Floral bracts* ± linear, obtuse, hirsute-tomentose, scarcely exserted. Limb and pollen-presenter bright orange; claws cream; style gold, gradually paler towards base where cream; indumentum white. *Perianth* 34–37 mm long including limb of 6–7 mm, ± straight, somewhat upturned, limb not reflexed before anthesis, ± 5 mm wide, tomentose outside with short, curled hairs and loosely hirsute with long spreading ones, glabrous inside; limb fusiform, ± navicular, obtuse, densely tomentose and hirsute outside, glabrous inside. *Anthers* 3·5 mm long, obtusely apiculate; filament 1 mm long. *Hypogynous scales* oblong, truncate, ± 2 mm long. *Pistil* 39–45 mm long, markedly bowed upwards after anthesis and projecting 5–10 mm, gradually tapered, glabrous; pollen-presenter 4–6 mm long, base swollen, then narrowed, with a central smaller swelling, upper half ± fusiform, finely ribbed, obtuse; stigmatic groove slightly oblique at apex; ovary glabrous except an apical ring of straight hairs longer on upper side. *Infructescence* 4–5·5 cm thick; perianths and styles

deciduous; follicles up to 60 but usually ± sparse; braets indurated, the common braets ± pungent. *Follicles* elliptic-oblong in plan view, 14–20 mm long, 3–6 mm high, 6–11 mm wide; valves semi-elliptic, smooth, mottled grey and brown, hirsute-tomentose; apex slightly ridged, obtuse, with short beak at stylar point; suture very fine; follicles opening when mature or with fire; valves ± recurved, split on each side of stylar point to leave beak ± 5 mm long and 5 mm wide; lips ± 1 mm wide on stylar side, widening to 2 mm wide on opposite side. *Seed* cuneate-obovate, 16–19 mm long; seed body cuneate, 8–10 mm long, 5–6 mm wide, obtuse at base, upper margin angled, ± acutely edged; lateral margins ± acute inner surface ± convex with raised margins, black, glistening, with a few small obtuse projections, otherwise smooth; outer surface convex, irregularly ridged, grey; wing 10–11 mm wide, but curved to stylar side where notched, slightly wrinkled, outside grey-brown, inside dark brown. *Separator* cuneate, 18–20 mm long, 10–13 mm wide, base obtuse, impressed against seed body, thickened above with overhanging ridge; a thick beak at stylar point; wings rounded.

Distribution. (Fig. 51) South West Western Australia, from Tamala Station (south of Shark Bay) south to Wagin, and inland as far as Wongan Hills and Quairading.

Selected collections. Shark Bay, October 1877, *F. Mueller* s.n. (MEL, PERTH); Utakarra, 3 miles (4·8 km) east of Geraldton, 26 August 1970, *R. Coveny* 3034 (NSW, PERTH); Lake Indoon, 27 April 1978, *R. Hnatiuk* 780084 (PERTH); 10 miles (16 km) west of Ballidu, 21 April 1959, *T. E. H. Aplin* 416 (PERTH); 29 miles (47 km) south east of Quairading on road to Babakin, 22 May 1960, *A. S. George* 834 (PERTH); Lime Lake (near Wagin) 25 June 1964, *K. Newbey* 1290 (PERTH); Subiaco, lower Swan River, 28 June 1900, *A. Morrison* s.n. (AD, CANB, PERTH).

Habitat. In deep sand, usually yellow or white, forming low open-woodland or tall shrubland; often very common and dominant in the upper storey.

Flowering period. February to August with the peak from March to May.

Banksia prionotes is locally very common through most of its range which extends much farther than any other species of the series *Crocinae*. Inland populations between Dalwallinu and Wagin are mostly isolated pockets since soils in these areas generally are heavy and unsuited to the species. There is some variation in habit, from a spreading shrub to an erect tree 10 m tall, and there is also variation in size especially of leaves and follicles. The largest leaves recorded—3 cm wide—are in a collection from south east of Tamala Station, near Shark Bay. With age the plants become moribund and often die; while there is some natural regeneration at any time, the most extensive and vigorous regeneration occurs after fire, which kills the parent plants. Within the *Crocinae Banksia prionotes* is probably related most closely to *B. burdetti* E. G. Baker. It is usually a much larger plant than *burdettii* (which is always a shrub), the leaves are longer and more deeply lobed with a different venation, the follicles are smaller and the old perianths are deciduous. From *B. victoriae* Meissner it can be distinguished by the hirsute-tomentose (not woolly) new leaves and involucral braets, the less deeply lobed leaves, the smaller follicles and the deciduous old perianths.

Figure 50. *Banksia victoriae*. A—Habit, 3 m tall. B—Bark. (Both N of Northampton, W.A.).

24. Banksia victoriae Meissner (Figure 50)

Hook. Journ. Bot. and Kew Gard. Misc. 7:119 (1855)—*Sirmuellera victoriae* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Drummond, coll, vi. n. 203". Lecto: NY, labelled by Meissner "victoriae nob. (27 Oct. 54)."; Iso: BM, CGE, FI, K, LD, MEL, NSW, OXF, P, U. The sheet at MEL bears the Drummond number 212 but this I take to be an error since Drummond collected *B. victoriae* only once.

Cotyledons (Fig. 8.22) obovate with upper margins crenulate, spreading to ascending, concave, 14–15 mm long, 12–13 mm wide, medium green, faintly reticulate; auricles horizontal to slightly descending, obtuse, 2 mm long. *Hypocotyl* 4–5 mm long, 2 mm thick, glabrous, pale pink-green. *Seedling leaves* crowded above cotyledons; first 2 lanceolate to narrowly obovate, acute, 2·5–3 cm long, 9–10 mm wide; margins slightly recurved, each side with 3 obliquely triangular obtuse lobes 2–3 mm long, the distal margins convex; sinuses obliquely V-shaped; lamina hirsute above, hirsute below on midrib with loose wool in lacunae; tapering to base; higher leaves 5–9 cm long, 14–23 mm wide, lobed almost to midrib, the lobes narrowly to broadly triangular, acute.

Mature plant a shrub or eventually tree to 7 m, without lignotuber, much-branched, spreading. *Bark* smooth, grey-mottled. *Branchlets* densely hirsute with long spreading hairs and tomentose with short curled hairs, gradually wearing off; bracts at base of branchlet linear-terete, sometimes slightly clavate, acute or obtuse, 1–3 cm long, densely hirsute-tomentose, the long hairs more dense towards apex. *Leaves* broadly linear, truncate with obtuse mucro (the latter when young acuminate, 5–8 mm long and hirsute) 15–35 cm long, 2·5–4 cm wide, divided throughout above 3/4 way to midrib; lobes up to 26, triangular, obtuse to acute, pungent, up to 1·5 cm long, to 2·5 cm wide across base, the margins gently sigmoid, flat; sinuses V-shaped; apices of lobes glabrous; lamina above when young densely tomentose with curled hairs, ferruginous becoming glabrous, densely tomentose below with curled hairs, the midrib hirsute with long hairs, becoming glabrous except fine white wool in lacunae; some leaf indumentum often persistent until next flowering; lateral nerves evident below, at ± 90° to midrib but curved towards apices of lobes, finely reticulate between. *Inflorescence* terminal to recent branch, conspicuous, 7–8 cm wide at anthesis. *Axis* 7–12 cm long, 6–7 mm wide, 18–22 mm wide with common bracts, bearing flowers throughout except a few mm at base and apex. *Involucral bracts* linear- subulate with broad bases, outer ones 1–2 cm long, thick, inner up to 4 cm long, slender, all densely hirsute with hairs ± curled at base, persistent until fruit. *Common bracts* linear, 10–11 mm long, densely hirsute with pale-ferruginous hairs; exserted apex narrowly conical acute, 3–4 mm long, tomentose with curled hairs and at extreme apex with a few long hairs. *Floral bracts* linear, 7 mm long, scarcely exserted, densely hirsute. *Flowers* pale pink in bud, bright orange when open, with pinkish-white indumentum. *Perianth* 38–40 mm long including limb of 8–9 mm, ± straight, somewhat upturned; claws 0·6 mm wide, outside tomentose to shortly hirsute with hairs curled at base, a few long hairs toward apex, inside glabrous; limb fusiform, navicular, densely hirsute and tomentose outside, glabrous inside. *Anthers* ± 2 mm long, obtuse with red apiculum; filament 2 mm long. *Hypogynous scales* broadly oblong, obtuse and slightly irregular, 1–1·5 mm long. *Pistil* 37–43 mm long, bowed, cream becoming orange distally, after anthesis projecting + 5 mm above perianth, ± 1 mm thick above ovary, tapering upwards, glabrous; pollen-presenter 5–6 mm long, the lower half narrower than slightly thickened style apex, terete, orange when fresh; a central swelling; upper half ± fusiform, finely 8-ribbed, bright yellow grading to obtuse red apex; stigmatic groove ± elliptic, slightly oblique; ovary glabrous except an apical ring of straight hairs. *Infructescence* ± 6 cm wide; perianths and styles long-persistent. *Follicles* up to 30, elliptic in plan view, 22–28 mm long, 10–15 mm high; 13–15 mm wide, valves semi-elliptic with lateral beak at stylar point, convex, smooth, densely hirsute and tomentose, dark brown turning dark grey; ridge rounded; suture fine; usually opening only with fire, to 3 mm across, valves ± recurved, split from stylar point leaving lateral beak ± 1 cm long as well as beak on main valves; lips 1·5 mm wide, widening to 2 mm on anti-stylar side. *Seed* obliquely obovate, 23–29 mm long; seed body triangular, 9–12 mm long, 7–9 mm wide; base acute; lateral

margins ± straight, thin, incurved; upper margin with prominent angle, thickened to ridge on inner side; inner surface ± flat, black, with scattered low tubercles; outer surface convex, dark grey with scattered low tubercles; wing 15–18 mm wide, curved to stylar side where notched leaving lateral lobe 5 mm long, undulate, black inside, dark grey outside. *Separator* ± obovate, 23–28 mm long, 14–20 mm wide; base impressed against seed body flat, acute; wings thickened above seed body with overhanging ridge, also with thick beak at stylar point; wings ± thin.

Distribution. (Fig. 51) South West Western Australia, between the lower Murchison River and Northampton, about 20–30 km inland.

Selected collections. Murchison River, no date, *Oldfield* 696 (MEL); Bakers Well near Murchison River, 29 September 1926, *C. A. Gardner* 2028 (PERTH); 12 miles (20 km) north of Northampton on road to Chilominey, 1 January 1972, *A. S. George* 11215 (AD, BRI, CANB, K, MEL, NSW, PERTH).

Habitat. In deep yellow or pale red sand, forming tall shrubland, associated with *B. attenuata* and *B. sceptrum*.

Flowering period. January and February.

Banksia victoriae and *B. prionotes* Lindley are closely related, the former being recognised by it woolly new growth and involucral bracts, its more deeply lobed leaves and its larger follicles surrounded by persistent old flowers. Although *B. victoriae* grows within the range of *B. prionotes* the two are never sympatric. Only a few populations of *victoriae* are known, but it occurs within Kalbarri National Park.

Banksia victoriae flowers earlier than *prionotes* and has a short flowering period, so that it is finished or almost so by the time *prionotes* begins.

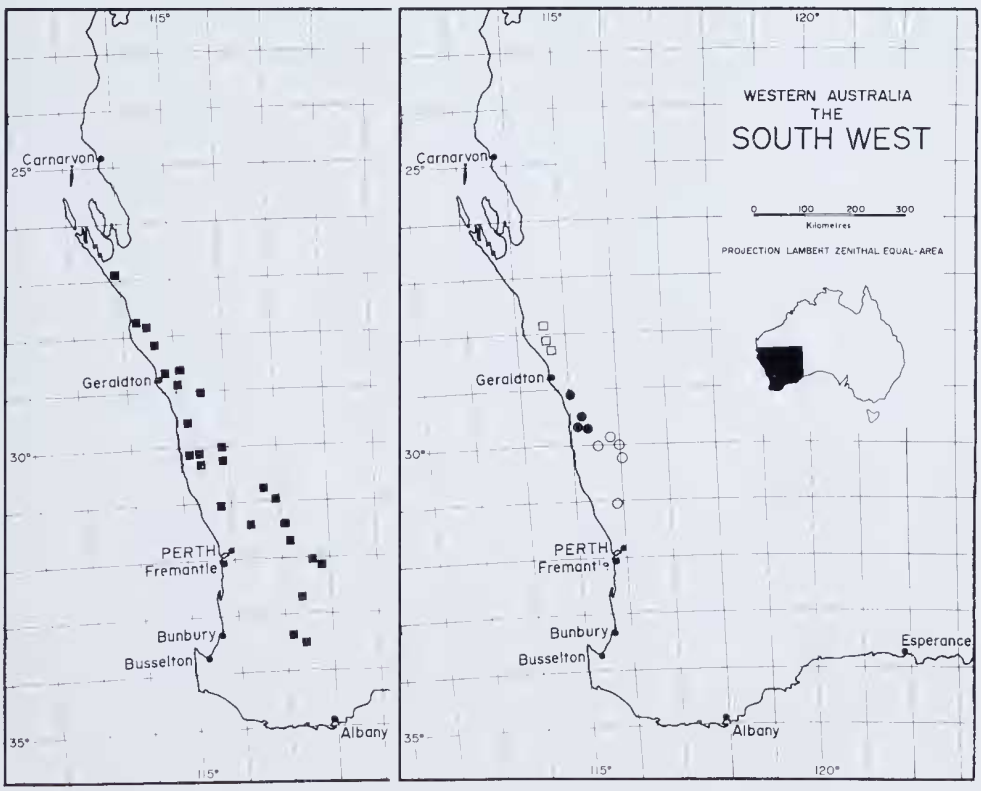


Figure 51. Distribution of *Banksia prionotes* (■), *B. victoriae* (□), *B. hookerana* (●), and *B. burdettii* (○).

25. Banksia hookerana Meissner

Hook. Journ. Bot. and Kew Gard. Misc. 7:119 (1855) (as *Hookeriana*)—*Sirmuellera hookerana* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Drummond, coll. vi. n. 202". Lecto: NY; iso: BM, CGE, FI, K, LD, MEL, NSW, P, U.

Cotyledons broadly obovate, 14–15 mm long, 12–13 mm wide, ascending, faintly 3-nerved towards base, medium green; auricles descending to vertical, acute, 1·5 mm long. *Hypocotyl* 1–1·5 cm long, 1·5 mm thick, glabrous, green. *Seedling leaves* first 2 opposite, ± 5 mm above cotyledons, broadly linear, 4–5 mm long, 11–12 mm wide, divided each side almost to midrib into 8–9 narrowly triangular obtuse lobes, somewhat oblique, the margins slightly recurved; lamina loosely hirsute above and on midrib below, loosely woolly below; tapering to base, sessile; higher leaves scattered, narrowly obovate to broadly linear, to 5 cm long, 14 mm wide, otherwise similar but with more numerous lobes. *Seedling stem* hirsute and densely tomentose.

Mature plant a shrub to 3 m tall and 3 m broad, without lignotuber, much-branched and bushy. *Branchlets* 1-several arising just below a node, 15–25 cm long, tomentose, not always producing an inflorescence, sometimes showing two growth periods between nodes. *Leaves* on upper 2/3–3/4 of branchlet, scattered but more crowded towards apex, spreading and gently curved upwards, linear but gradually broadening towards apex, 6–16 cm long including petiole of 5–15 mm, those in lower part of branchlet and immediately below inflorescence the shorter; lamina 5–12 mm at widest including lobes, flat or slightly concave or convex, lobed almost from base with 20–45 lobes on each side, the lobes ± triangular, 1–3 mm high, 1–6 mm broad, obtusely mucronate, distil side shorter than proximal, gently concave to sigmoid, proximal side almost straight; sinuses V-shaped with an angle of 60°–120°, usually ± 90°, rarely shallowly U-shaped; lamina almost smooth above, midrib slightly raised; lateral nerves evident below at an angle of 80°–90° but lateral ones to each lobe incurved towards apex of lobe, reticulate and finely pitted between, midrib prominent below. *Inflorescence* terminal on recent branchlet, conspicuous, cylindrical or slightly tapered upwards, 9–10 cm wide at anthesis. *Involucral bracts* numerous, persistent, linear-subulate, mostly 1–2 cm long, densely hirsute with both long, straight hairs and short, curled ones. *Axis* 7–12 cm long, 4–6 mm wide including common bracts, bearing flowers throughout. *Common bracts* linear, slightly broader above middle, 2 mm long, densely ferruginous-hirsute, the hairs more spreading and paler above middle, shorter and darker towards apex with a few long ones at apex. *Floral bracts* similar but slightly shorter and narrower. *Flowers* bright orange but the outer side ± obscured by pale pink indumentum; style golden-orange. *Perianth* 32–35 mm long including limb of 6–7 mm; claws filiform, 0·5 mm wide, pubescent outside with crisped and straight ascending hairs, becoming hirsute below limb, glabrous inside, free except for the lowest third; limb narrowly fusiform, densely hirsute with straight hairs, shortest at apex. *Anthers* 3–4 mm long, filaments short, connective produced for 0·5 mm. *Hypogynous scales* oblong, obtuse, entire, 2 mm long. *Pistil* 39–45 mm long, curved, glabrous; pollen-presenter 4–5 mm long, narrow but with swelling in centre, slightly ribbed; stigmatic groove lateral just below apex; ovary with a few hairs around apex, those on the lower side longer, few on upper side, otherwise glabrous. *Infructescence* ± ovoid, the old perianths persistent and ± concealing follicles for some years. *Follicles* in plan view narrowly elliptic, 20 mm long, 5–7 mm high, 10 mm wide, valves ± smooth but hirsute, suture scarcely evident; opening with fire, to 6–12 mm wide, apical margins slightly recurved, splitting in 2 notches on stylar side. *Seed* ± obovate, 24 mm long; seed body cuneate, acute at base, 8–14 mm long, 8–12 mm wide, the upper margin oblique, thickened and flanged, the lateral margins slightly curved; inner surface flat, smooth, black, ± shining; outer surface convex, irregularly rugose or pitted, black; wing curved to stylar side where deeply notched leaving obtuse lobe, grey-black. *Separator* similar to seed in outline; an oblique, overhanging ridge across centre on each side; stylar side above this thickened and produced into a transverse, obtuse beak, each wing separated from it by a fissure.

Distribution. (Fig. 51) South West Western Australia, chiefly from Arrowsmith Lake to Lake Logue and Eneabba, with a few populations north to Allanooka and up to 10 km south of Eneabba.

Selected collections. Allanooka, 25 Aug. 1965, *A. Kessell* s.n. (PERTH); N of Arrowsmith Lake, 16 Oct. 1969, *A. S. George* 9776 (PERTH); NE from Lake Logue, 27 Aug. 1948, *C. A. Gardner* 7113 (CANB, K, NSW, PERTH); Ca. 8 km S of Eneabba, 27 April 1978, *R. Hnatiuk* 780085 (CANB, PERTH).

Habitat. In deep white or yellow sand forming shrubland, often dominant; sometimes associated with *B. attenuata, B. elegans* and *Eucalyptus todtiana.*

Flowering period. Late April to October, with a peak in July-August.

Banksia hookerana is easily recognised among the series *Crocinae* by its narrow leaves with many small, triangular lobes. Its closest relative is *B. prionotes* from which it differs further in the hirsute inflorescence bracts and the larger follicles hidden within persistent old flowers. It is the most floriferous species of the series. Although of restricted range it is locally common, but much of the region in which it occurs is being used for agriculture or mining of mineral sands. It is killed by fire and regenerates from seed.

An interesting collection was made near Eneabba on 29 June 1972 by H. McDonald-Smith (PERTH). Found among a large population of *B. hookerana*, it is in all respects a miniature variant, with leaves 3–4 cm long and perianths 2 cm long in small inflorescences 2–3 cm long. Only two plants were seen and neither bore fruit.

26. Banksia burdettii E. G. Baker

Journ. Bot. 72:281 (Oct. 1934).

Type citation: "WEST AUSTRALIA: Watheroo, about 120 miles NE of Perth, *W. Burdett*, sine no." Lecto (here chosen): BM A sheet labelled Type Specimen and annotated by Baker: "Watheroo 120 miles NE of Perth. Coll. W. Burdett". There is also a dehisced fruit in the carpological collection at BM.

Cotyledons (Fig. 8.23) widely spreading, transversely semi-elliptic, 6–7 mm long, 11–12 mm wide, convex, light green with fine red margins, nervation not evident; auricles descending, acute, 1·5 mm long. *Hypocotyl* thick, short, glabrous. *Seedling leaves* close above cotyledons; first 2–4 leaves narrowly elliptic-lanceolate in outline, 3–8 cm long, 11–13 mm wide, obtuse, mucronate, deeply divided (almost to midrib) into obliquely triangular lobes, the largest 5–6 mm long, those towards apex and base 2–3 mm, obtuse to acute; margins of lobes slightly curved, the upper shorter than lower, flat to slightly recurved; venation coarsely reticulate, evident on both sides when dry, loosely hirsute with spreading hairs above becoming glabrous, white-tomentose below, less densely on veins, midrib loosely hirsute. Next leaves larger with shorter lobes, by 5th or 6th leaf, ± linear-oblong but tapered to base, less so to apex, truncate, mucronate, 10–15 cm long, 11–19 mm at widest, dentate; lobes obliquely dentate, 1–3 mm long, 2–8 mm wide across base, mucronate or acute, the apices often turned forwards, margins slightly convex to sigmoid, slightly recurved, distal shorter than proximal; sinuses V-shaped; upper surface tomentose with curled and spreading hairs, becoming glabrous, lower surface tomentose with curled hairs and, on the midrib, spreading hairs, pale ferruginous when young.

Mature plant a shrub to 4 m without lignotuber but much branched and bushy. *Branchlets* pinkish, closely tomentose with pale brown curled persistent hairs, becoming grey; prophylls of branchlets narrowly linear, ± obtuse, 9–13 mm long, tomentose and hirsute, deciduous. *Leaves* narrowly cuneate-oblong, truncate, 10–16 cm long, 15–25 mm wide, tapered to petiole of 5–20 mm, dentate except towards base; teeth ± triangular, 1–2 mm long, obtuse to acute, margins ± concave, the distil slightly shorter; sinuses U-shaped; margins slightly recurved; upper surface tomentose with curled hairs and tomentose with spreading ones but soon glabrous, nervation obscure; lower surface tomentose with persistent curled hairs as well as spreading ones on nerves, these more numerous on midrib, pale ferruginous; nervation conspicuous, with parallel nerves at 80°–85° to midrib, forked towards margins; petiole very convex below, densely hirsute becoming tomentose, pale ferruginous. *Inflorescence* terminal on branchlet usually less than a year old, conspicuous, 7–8 cm wide at anthesis. *Axis* 6–10 cm long, 4–5 mm wide, 14 mm wide with common bracts, bearing flowers throughout except for 4–5 mm at base. *Involucral bracts* linear-subulate from thick bases, 5–10 mm long, tomentose with pale

brown curled hairs and hirsute with spreading ones, bracts mostly deciduous by end of flowering. *Common bracts* narrowly cuneate, 4·5–5 mm long, densely ferruginous-hirsute; exserted apex shortly conical, slightly upturned, tomentose and loosely hirsute, apex pale brown. *Floral bracts* similar but narrower, 4–4·5 mm long, exserted apex small. *Flowers* bright orange inside, pale outside and with white indumentum. *Perianth* 34–35 mm long including limb of 5–6 mm; claws 0·3 mm wide, broader towards base, outside loosely hirsute with straight, spreading hairs mixed with tightly short, curled hairs, glabrous inside; limb linear, obtuse, densely tomentose-hirsute, hairs sparse at base. *Anthers* 2·5–3 mm long, apiculate; filaments ± 1 mm long. *Hypogynous scales* oblong, obtuse, 1·5 mm long, somewhat cohering. *Pistil* 35–38 mm long, curved throughout, glabrous, slightly scabrous; pollen-presenter cream with yellow apex, 4–5 mm long, linear, quadrangular, abruptly narrowed above junction with style then again narrowed in upper half with slight swelling at middle, obtuse, apex minutely globular; stigmatic groove terminal; ovary glabrous except a few short hairs below apex on each side. *Infructescence* with perianths and styles long persistent, almost concealing follicles. *Follicles* up to 20, narrowly-elliptic in plan view, 2–2·5 cm long, 5–10 mm high, 8–10 cm wide; valves semi-elliptic, smooth, densely hirsute; ridge rounded; suture fine; follicles opening usually with fire, valves spreading to 1–1·5 cm, each with a split ± 5 mm deep from stylar point, leaving lateral beak; lips 1 mm wide. *Seed* obliquely obovate, 14–16 mm long; seed body transversely elliptic, 9–10 mm long, 12 mm wide, obtuse at base, margins thin, outer surface pale grey, ± smooth but with ± reticulate shallow brown pits, especially in band around margin; inner surface tawny-mottled, ± convex, with many linear, erect processes ± 1 mm long; wing 13–15 mm wide, dark brown, with notch above stylar point, decurrent on both sides of seed body. *Separator* similar to seed in outline, 14 mm long, 12–17 mm wide, with concave, shallow-pitted depressions against seed body, thickened above especially below stylar point which is beak-like with a split each side.

Distribution. (Fig. 51) South West Western Australia, between Cnabba and Mogumber; intermittent along a belt about 50–100 km inland.

Selected collections. 17 km S of Cnabba-Carnamah road along Willis road, 27 March 1977, *A. S. George* 14425 (seedlings, burnt fruit) (PERTH); between Marchagee and Coorow, May 1939, *Miss Frape* s.n. (PERTH); 10 miles (16 km) NW of Mogumber, 26 August 1964, *K. Newbey* 1413 (PERTH).

Habitat. In deep white or yellow sand as a component of tall shrubland over open heath; sometimes locally common, but the recorded populations generally small.

Flowering period. Late January to May, with a peak in February-March.

Banksia burdettii has a restricted distribution and may be considered endangered. Most of the land in the area where it is found has been alienated for agriculture, and only populations in Alexander Morrison National Park could be secure provided they are properly managed.

The species is most closely related to *B. prionotes* Lindley and is distinguished by its dentate leaves with parallel secondary nerves and by its larger follicles surrounded by the persistent old flowers. Its flowering period coincides with the first half of that of *B. prionotes* but there is a peak in February-March after which it quickly tails off. It is the only species of the series with a muricate inner surface of the seed body.

Baker considered *B. burdettii* to be related to *B. baueri* and more closely so to *B. prionotes* and *B. menziesii*. The first of these is unrelated to *burdettii;* the last resembles it in leaf size and dentation but not in morphology of flowers and fruit.

Series **Cyrtostylis** (Benth.) A. S. George, stat. nov.

Banksia section *Cyrtostylis* Benth., Fl. Austral. 5:542 (1870).

Type species: **B. media** R.Br., lecto. nov.

Shrubs or *trees*, with or without lignotubers or fire-tolerant stems. *Leaves* serrate or triangular-lobed, the margins flat or slightly recurved. *Inflorescence* terminal or on short lateral branchlet, cylindrical or sometimes spherical, erect or in 1 species pendulous.

Perianth quite straight or sometimes with the limb somewhat upturned before anthesis, relaxed after anthesis, yellow, ferruginous, orange or reddish. *Pistil* straight or gently curved; pollen-presenter usually less than 3 mm long, slightly thickened, finely costate or smooth. *Follicles* elliptic, mostly less than 2 cm long, laterally beaked after opening. *Cotyledons* obovate to rounded-cuneate, often crenulate, sometimes emarginate.

This, the largest series in the section *Banksia*, contains the following 12 species, all endemic in South Western Australia: *B. ashbyi* E. G. Baker, *B. attenuata* R.Br., *B. audax* C. Gardner, *B. benthamiana* C. Gardner, *B. elderana* F. Muell. & Tate, *B. elegans* Meissner, *B. laevigata* Meissner, *B. lindleyana* Meissner, *B. lullfitzii* C. Gardner, *B. media* R.Br., *B. pilostylis* C. Gardner and *B. praemorsa* Andrews.

The series as here defined differs considerably from Bentham's concept of it as a section. Of the 10 species included by him only 3 are here retained, the others being removed to three other series. Three species which Bentham placed in his section *Orthostylis* belong here, viz. *B. elegans*, *B. laevigata* and *B. praemorsa;* the last is closely related to *B. media*, a relationship overlooked by Bentham. The other species of the series have been described since Bentham's time.

The series is rather heterogeneous. The typical members of the series are *B. media*, *B. pilostylis* and *B. praemorsa*. From these *B. attenuata* differs chiefly in its large, emarginate cotyledons. *Banksia lindleyana* has large, rather openly arranged flowers which indicate a link with the series *Tetragonae*. *Banksia ashbyi*, *B. benthamiana* and *B. audax* diverge in the orange flowers and small follicles. *Banksia laevigata* is distinguished from the remainder of the series by its fine, crowded flowers in spherical inflorescences. *Banksia elderana* closely resembles *B. lindleyana* in its floral morphology but differs markedly in its pendulous inflorescences and very long, rigidly dentate leaves. *Banksia lullfitzii* forms a link between *B. audax* and *B. elderana*, having the long, rigid leaves and long perianth of the latter with the floral colour and indumentum of the former. The most anomalous species of the series is *B. elegans* which, while showing relationships to *B. attenuata* in its flowers and to *B. ashbyi* in its leaves, has a short, rounded inflorescence and few, obliquely ovoid follicles somewhat akin to those of *B. ilicifolia* R.Br.

27. Banksia media R.Br.

Prot. Nov. 35 (1830)—*Sirmuellera media* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid., inter Cape Arid et Lucky Bay, 1824. *D. Baxter.*" Lecto (here chosen): BM; syn: BM (including infructescences), NSW, PERTH. The lectotype is labelled, in Brown's hand, "Banksia media *nob.* Point Malcolm 1823 Mr. W. Baxter." The syntype at BM is labelled, in Brown's hand, "Banksia media nob. Mr. Baxter 1824 recd. abt. 1825" and, probably in Baxter's hand, "Point Malcolm & Cape Pasley". The sheets at NSW and PERTH are also dated 1823. The four sheets, although differently dated, are from the same expedition.

Cotyledons (Fig. 8.24) ± broadly obovate-cuneate, slightly oblique, widely spreading, 10–12 mm long, 9–11 mm wide, faintly reticulate, dull green, the upper margin sometimes finely crenulate; auricles descending to spreading, + acute, 2 mm long. *Hypocotyl* 5–12 mm long, ± 1·5 mm thick, dark red, glabrous. *Seedling leaves*: first 2 immediately above cotyledons, obovate-cuneate, acute ± 15 mm long, 13 mm wide; margins slightly recurved, 2-serrate on each side, the teeth acute, 3–5 mm long with curved edges; sinuses V-shaped; lamina loosely pubescent-hirsute above becoming glabrous, hirsute on midrib below, the lamina woolly; next 2–4 leaves similar but up to 5 cm long and 25 mm wide, with 3–6 teeth each side, tapering to petiole of 2–3 mm; higher leaves obovate, 5–8 cm long, 15–25 mm wide, obtuse to truncate, mucronate, serrate with many acute teeth 1–3 mm long; lamina appressed-pubescent above becoming glabrous, densely tomentose-hirsute below on midrib and shortly pubescent on lateral nerves becoming glabrous but with persistent white wool in lacunae; petiole 1–4 mm long. *Seedling stem* hirsute for 1–2 cm becoming glabrous, closely pubescent with curled hairs above and loosely hirsute.

Mature plant a shrub or sometimes a tree to 10 m without lignotuber, usually much-branched and spreading, up to 6 m across. *Trunk* stout, up to 30 cm diam. *Bark* up to 1 cm thick, becoming roughly fissured, not friable, grey. *Branchlets* slightly angular becoming terete, at first 1·5–2 mm diam., tomentose with curled pale brown hairs, becoming grey, glabrous after 2–3 years; prophylls at base of branchlet narrowly linear, obtuse, up to 8 mm long, tomentose, soon deciduous. *Leaves* narrowly cuneate, truncate, mucronate, mostly 4–10 cm long, 7–20 mm wide, sometimes up to 12 cm long and 25 mm wide; margins slightly recurved or flat, serrate for 1/2–3/4 of length, the teeth obtuse to mucronate, mostly 1–2 (sometimes 3) mm long; sinuses U-shaped, 2–8 mm wide or wider towards leaf base; lamina pubescent to hirsute above and on nerves below, becoming glabrous, lacunae below white-woolly; petiole 5–10 mm long, tomentose sometimes becoming glabrous. *Inflorescence* terminal to short leafy branchlet lateral to stem 3–5 years old, occasionally terminal to main branchlet, cylindrical, 7–8 cm wide at anthesis. *Axis* 6–16 cm long, 8–9 mm wide, 20–24 mm wide with common bracts, without flowers for ± 1 cm at base and up to 1 cm at apex. *Involucral bracts* narrowly linear on thick bases, up to 10 mm long, densely tomentose, deciduous before anthesis. *Common bracts* linear, 7–8 mm long, densely hirsute; exserted apex conical, acute, upturned, ferruginous-tomentose, with extreme apex glabrous, cream-brown. *Floral bracts* similar but narrower, with obtuse tomentose apices. *Flowers* golden yellow but soon turning brown, the limb often brown in bud; styles cream. *Perianth* 32–38 mm long including limb of 3–4 mm; gently curved, with the limb somewhat upturned before anthesis, relaxed after anthesis; claws linear, 0·5 mm wide, scarcely tapering, glabrous outside at base becoming appressed-pubescent towards limb, glabrous inside; limb narrowly elliptic-oblong, obtuse, glabrous. *Anthers* 1·5 mm long on filaments of 0·5 mm, obtusely apiculate. *Hypogynous scales* narrowly triangular, almost acute, 1·5 mm long, free. *Pistil* 33–40 mm long, gently sigmoid, slender, glabrous; pollen-presenter ± ovoid, 0·75 mm long, obscurely ecostate, with an oblique basal swelling; stigmatic groove lateral; ovary shortly hirsute to pubescent at apex. *Infructescence* stout, old perianths and styles persistent, the latter downturned. *Follicles* up to 70, at first ± concealed by old flowers, in plan view elliptic, 15–25 mm long, 8–14 mm high, 8–11 mm wide; valves semi-elliptic, slightly expanded to stylar side, gently convex, then rounded to suture, colliculate, sparsely hirsute becoming glabrous, brown; ridge obtuse; suture fine; follicles opening usually with fire, mostly to 10–20 mm across; valves somewhat recurved, split from stylar point leaving a broad beak; lips 1·5 mm wide, broadening to anti-stylar side. *Seed* ± obovate, 25–34 mm long; seed body obovate, 10–12 mm long, 5–7 mm wide, obtuse at base; inner surface convex especially at apex where slightly rugose, black, glistening; outer surface convex, slightly rugose, dark brown; stylar margin narrowly bordered; wing 11–20 mm wide, curved towards stylar side where split to seed body leaving narrowly ovate lobe, anti-stylar side decurrent to base of seed body. *Separator* ± obovate, 20–25 mm long, impressed against seed body, scarcely ridged above, narrowly beaked to stylar point; wings recurved only in upper 1/4.

Distribution. (Fig. 54) South West Western Australia; south coastal districts from near the eastern end of the Stirling Range to Israelite Bay, with eastern outliers at Point Culver and Toolinna (Nelson 1975). In the central part of its range the species extends inland to near Lake Cronin.

Selected collections. Near Point Irby, Beaufort Inlet, 29 March 1964, *A. S. George* 6155 (PERTH); Lake Magenta Reserve, 4 July 1963, *H. B. Shugg* s.n. (PERTH); Along rabbit-proof fence 20 miles (32 km) S of Jerramungup-Ravensthorpe road, 2 Oct. 1966, *R. Filson* 9141 (MEL, PERTH); Pt. Ann, Fitzgerald River National Park, Jan. 1976, *A. S. George* s.n. (PERTH); Frank Hann National Park, 7 Aug. 1978, *D. Monk* 317 (PERTH); S of Ravensthorpe, 16 Sept. 1925, *C. A. Gardner* 1790 (PERTH); 4 miles (6 km) S of Grass Patch, 18 April 1953, *R. D. Royce* 4065 (PERTH); 3 km north-east of Howick Hill, 22 Sept. 1968, *A. E. Orchard* 1164 (AD, PERTH); S end of Mt. Ragged, 6 Jan. 1979, *B. Barnsley* 331 (CBG, PERTH).

Habitat. In white sand or sandy loam, red clay, loam over limestone or occasionally in shale or granitic soil, in low open heath, tall shrubland and low open woodland.

Flowering period. Mainly March to August, with occasional flowers to December.

The diagnostic features of *B. media* are the lack of a lignotuber, the cuneate, dentate leaves usually with recurved margins, the golden yellow flowers, the appressed-pubescent perianths with glabrous limb, the glabrous pistil with very small pollen-presenter, and the colliculate follicles that are sparsely hirsute but soon glabrous.

The species shows some variation in habit and leaves. In a few coastal populations, e.g. at Pt. Ann, the plants are almost prostrate, so much so that the inflorescences protrude above the foliage. Although prevailing onshore winds would be partly the reason for this habit, it may to some extent be genetically controlled. Progeny from the Pt. Ann population in cultivation at PERTH and 3–4 years old are developing the same habit. The typical habit away from the coast is a much-branched, spreading shrub which may eventually become arborescent.

In the western and coastal part of its range, the species has leaves mostly 4–6 cm long and 10–20 mm wide. Inland populations, e.g. near Peak Charles and Mt. Ragged, have longer, narrower leaves with less revolute margins.

The closest relationship is with *B. praemorsa* which differs essentially in the always-flat leaves with small very obtuse teeth, the reddish flowers and the glabrous perianth. The two species are allopatric. Less closely related to *B. media* is *B. pilostylis* C. Gardner which is a usually smaller shrub with narrower leaves having more recurved margins, smaller inflorescences with tightly packed, pubescent perianths and hirsute pistils. *Banksia pilostylis* grows within the geographical range of *B. media* but the two have not been recorded growing together.

28. Banksia praemorsa Andrews

Bot. Rep. 4: tab. 258 (April–Dec. 1802)—*Sirmuellera praemorsa* (Andrews) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: none. The description was based on cultivated material, both the Royal Gardens at Kew and the Clapham collection being cited. A flowering specimen collected from Kew in 1802 is here nominated as the neotype. It is lodged at BM and has the annotation "Hort. Kew, 1802". The plants grown at this early period in Britain were raised from seed collected at King George Sound by Archibald Menzies in September-October 1791.

B. marcescens R.Br., Trans. Linn. Soc. London 10:208 (1810), nom. illeg., superfl. Type: as for *B. praemorsa* Andrews.

Cotyledons (Fig. 8.25) widely spreading, obovate, 10–11 mm long, 8 mm wide, faintly reticulate, medium green; margins slightly undulate, yellow; auricles ± 1 mm long, widely spreading, obtuse. *Hypocotyl* short, thick, glabrous, deep red. *Seedling leaves*: first 2 opposite, ± 3 mm above cotyledons; upper leaves scattered; all obovate to narrowly cuneate, mucronate, truncate, 15–35 mm long, 6–15 mm wide; margins flat, serrate, the teeth acute, 1–2 mm long; lacunae sparsely tomentose-hirsute above becoming glabrous, tomentose on nerves below and finely woolly in the lacunae, the nerves becoming glabrous. *Seedling stem* tomentose-hirsute, reddish.

Mature plant a shrub to 4 m without lignotuber. *Trunk* short, stout. *Bark* rough, flaking. *Stem* above base much-branched, the plants often spreading and kept low by onshore winds. *Branchlets* ± terete, closely tomentose with curled hairs, leafy except for first 2–3 cm which may bear a few narrowly linear tomentose prophylls 7–10 mm long, the prophylls usually absent from lateral branchlets. *Leaves* narrowly cuneate, truncate to retuse, obtusely mucronate, 2–6 cm long, 0·7–2·1 cm wide, abruptly narrowed to a petiole 2–5 mm long; margins flat or very slightly recurved, serrate in upper half, sometimes almost to base, rarely entire; teeth 1–3 mm long, distal margin much shorter than proximal, usually obtuse, rarely pungently acute; sinuses obtuse; lamina on upper surface loosely tomentose-hirsute with short, curled and long hairs, becoming glabrous; lower surface tomentose-hirsute when young, becoming glabrous except for fine white wool in the lacunae; midrib somewhat raised, orange-brown; lateral nerves at angle of 50°–70° to midrib, inconspicuous among the reticulate venation; new growth pale ferruginous-green. *Inflorescence* terminal or on branchlet often lateral to an older stem and then somewhat concealed in the shrub. *Axis* 10–27 cm long, 5–9 mm wide, 16–20 mm with common bracts, bearing flowers throughout except for ± 1 cm at apex. *Involucral bracts* numerous, narrowly linear to subulate, 5–17 mm long, densely tomentose-hirsute. *Common bracts* linear, 7 mm long, densely long-hirsute, the hairs becoming short and curled

on the exposed part; exserted apex narrow, acute to obtuse, upturned, almost glabrous, when young with a few terminal hairs. *Floral bracts* similar but 6 mm long, without the apical point. *Flowers* where exposed deep red-maroon, otherwise pale greenish-yellow; limb green with extreme apex yellowish; perianth pink inside at anthesis; rarely yellow throughout. *Perianth* 33–34 mm long, including limb of 4–5 mm, gently upcurved throughout; claws ± 0·4 mm wide, slightly narrowed but thickened upwards, with 3 close central nerves, glabrous throughout on both sides: limb narrowly fusiform, obtuse, ± keeled, when dry the central nerve prominent, lateral ones less so. *Anthers* 2·5 mm long, including filament of ± 0·8 mm and obtuse apiculum of ± 0·3 mm. *Hypogynous scales* oblong, ± 0·5 mm long. *Pistil* ± 31 mm long, gently curved, glabrous; pollen-presenter erect, ± cylindrical but with slight kink at base, obtuse, 1 mm long, slightly ribbed; stigmatic groove terminal; ovary glabrous except for short, straight hairs about the apex. *Infructescence* cylindrical, 5–8 cm diam.; old perianths and styles persistent for many years and often quite concealing follicles, the styles usually curled or bent. *Follicles* narrowly elliptic in plan view, 18–20 mm long, 7–10 mm wide, 6–9 mm high; valves semicircular, convex, colliculate, glabrous; suture fairly prominent, slightly undulate; follicles usually opening with fire, the valves opening 5–10 mm, not recurved; lips 1–2 mm wide, broader on side opposite style; a split on each side of style base leaving a broad beak. *Seed* obliquely obovate but notched on stylar side, 20–22 mm long; seed body 10–11 mm long, 6–8 mm wide, base ± acute, wing extending ± halfway down side opposite style, both surfaces slightly rugose, dark grey; wing 13–15 mm wide, dark brown on both sides. *Separator* similar to seed in outline but without notch on stylar side, brownish black, 20–22 mm long, 14–17 mm wide.

Distribution. (Fig. 54) South West Western Australia; on the south coast between Albany and Bald Island.

Selected collections. "Swan River" (colony), *J. Drummond* 285 (CGE, G, MEL, OXF, PERTH); Torndirrup National Park, 19 July 1971, *A. S. George* 10879 (CANB, MEL, NSW, PERTH); Bald Is., May 1963, *G. M. Storr* s.n. (PERTH); Nanarup Beach, E of Albany, Oct. 1969, *Cook* s.n. (MEL).

Habitat. On steep, stabilised coastal sand dunes, often overlying granite or limestone, in mixed heath.

Flowering period. August to November.

Banksia praemorsa is very localised, being known from only a few localities on the south coast near Albany. It grows on the seaward-facing slopes of sand dunes and is usually kept low by prevailing onshore winds. The flowers are somewhat concealed by the foliage, and the plants tend to be inconspicuous.

Characteristic features of the species are the lack of a lignotuber, the short, flat, obtusely dentate leaves; the deep red and greenish-yellow glabrous flowers; and the colliculate follicles. The close relationship to *B. media* is discussed under that species. *Banksia praemorsa* shows little variation.

29. Banksia pilostylis C. Gardner (Figure 52)

J. Roy. Soc. W. Austral. 47:57 (13 July 1964).

Type citation: "Hab. in distr. Eyre in arenosis inter flumina Oldfield et Young septentrionalem versus ad collibus "Fitzgerald Peaks" in arenosis dunosis fruticetis, etiam prope Starvation Boat Harbour, fl. m. Oct. *Gardner* 12149 (TYPUS)." Lecto: PERTH, "prope flumen Young", 18 Oct. 1960, *C. A. Gardner* 12891. I have not found any sheet of Gardner 12149.

Cotyledons (Fig. 8.26) broadly obovate but somewhat flattened at apex, horizontal, ± flat, 15 mm long, 15 mm wide, very faintly reticulate or nerveless, margins red; auricles descending, ± acute, 2 mm long. *Hypocotyl* stout, 1–1·5 cm long, glabrous, dark red. *Seedling leaves*: first 2 opposite, 2–3 mm above cotyledons, narrowly obovate, tapering to petiole 2–4 mm long, obtuse, 25–30 mm long, 14 mm wide; margins recurved, dentate with 2–3 ± triangular acute lobes 2–3 mm long; upper surface ± reticulate, shortly and sparsely hirsute with white hairs; lower surface hirsute on midrib, the lamina woolly; higher leaves scattered, obovate to narrowly cuneate, 4·5–7 cm long, 1·5–2·5 cm wide,

obtuse to truncate; margins recurved, dentate with 5–7 triangular acute lobes up to 5 mm long; sinuses ± V-shaped; upper surface sparsely pubescent; lower surface hirsute on midrib, lamina woolly; petiole 3–5 mm long. *Seedling stem* red-brown, hirsute for 1–2 cm, then hirsute and pubescent.

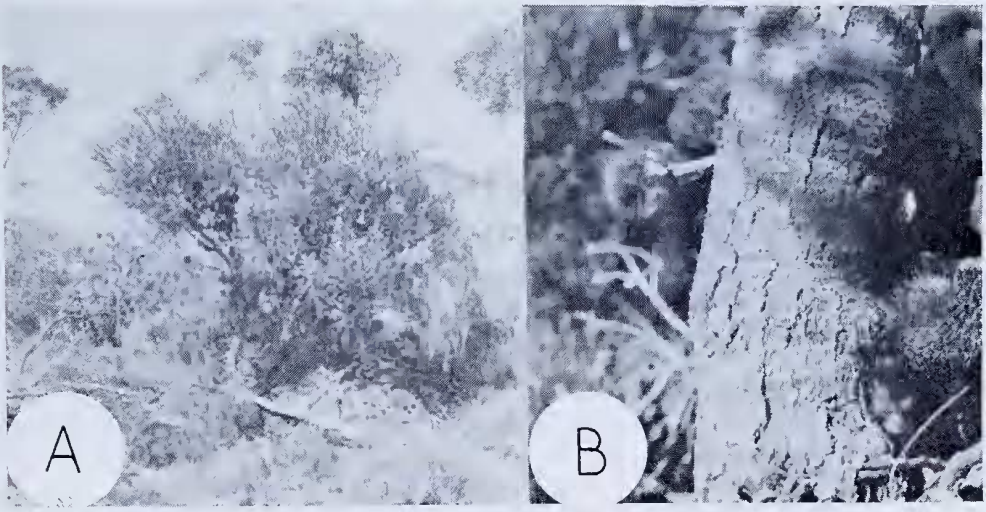


Figure 52. *Banksia pilostylis*. A—Habit, 3 m tall. B—Bark. (Both NE of Mt. Burdett, W.A.).

Mature plant a shrub to 4 m without lignotuber, much-branched and bushy. *Trunk* to 15 cm diam. *Bark* 2–3 mm thick, smooth at first, becoming roughly fissured, not friable, grey. *Branchlets* terete, 2–3 mm diam., densely tomentose with curled hairs, ferruginous, the indumentum turning grey and wearing off after 3–4 years; prophylls well spaced along lower 2–5 mm of branchlets, narrowly linear, obtuse, 5–10 mm long, densely tomentose-villous, deciduous. *Leaves* scattered, very narrowly cuneate, truncate or obtuse, mucronate, 5–16 cm long, 5–20 mm wide; margins recurved, serrate almost to base; teeth obtuse, pungently mucronate, 1–4 mm long; sinuses broadly and obliquely U-shaped, 4–15 mm wide; lamina densely tomentose and hirsute above becoming glabrous; midrib below densely tomentose and hirsute, the reticulum tomentose and loosely hirsute, all becoming glabrous, lacunae white-woolly; petiole 4–6 mm long, tomentose; new leaves ferruginous. *Inflorescence* usually on short leafy lateral branchlet from main stem, but also terminal to main branchlet, cylindrical, 5–5·5 cm diam. at anthesis. *Axis* 5–10 cm long, 8–9 mm diam., 16–18 mm diam. with common bracts, bearing flowers throughout except at extreme apex. *Involucral bracts* numerous, subulate on thick bases, 5–20 mm long, densely tomentose to villous; many persistent until flowering. *Common bracts* linear, 4–5 mm long, densely hirsute; exserted apex narrowly conical, obtuse, tomentose, sometimes penicillate, deeply ferruginous with pale apex. *Floral bracts* similar but slightly shorter and narrower with smaller apex. *Flowers* tightly packed, pale yellow, usually pale ferruginous at apex of axis; styles cream. *Perianth* 20–24 mm long including limb of 2–2·5 mm, straight or slightly downcurved, the limb upturned before anthesis; claws filiform, 0·3 mm wide above base, long-hirsute outside, hirsute inside along margins in upper half; limb narrowly elliptic, obtuse, somewhat keeled, 1-nerved each side, tomentose, also shortly hirsute, the hairs often wearing away especially at apex. *Anthers* 1–1·5 mm long on filaments of 0·5 mm, prominently apiculate. *Hypogynous scales* linear, obtuse, ± 1 mm long. *Pistil* 23–27 mm long, curved gently down, prominently upturned below pollen-presenter, loosely hirsute with long spreading hairs; pollen-presenter not thickened, 0·7–1 mm long, obtuse, finely costate; stigmatic groove terminal; ovary hirsute with long straight hairs at apex especially on lower side. *Infructescence* moderately robust; old perianths and styles persistent. *Follicles* up to 25,

rather prominent especially as perianths wear away, in plan view elliptic, 22–35 mm long, 15–20 mm high, 10–16 mm wide; valves semi-circular, slightly expanded to stylar side, gently convex, then strongly rounded to obtuse ridge, colliculate, tomentose but exposed parts becoming glabrous, brown; suture narrow; follicles opening usually with fire, to 15 mm wide; valves scarcely recurved, split from stylar point leaving a broad beak; lips 1–1·5 mm wide, broadening slightly on anti-stylar side. *Seed* broadly obovate, 25–30 mm long; seed body broadly obovate-cuneate, 9–10 mm long, 10–11 mm wide, obtuse at base; lateral margins convex, upper margin thickened, rugose; inner surface flat, smooth to slightly rugose, black-brown, glistening; outer surface convex, with scattered small ridges, grey, shining; wing 21–25 mm wide, curved to stylar side where deeply notched, annular about seed body. *Separator* similar to seed in shape and size, moderately robust, impressed against seed body, with a small overhanging ridge above, broadly beaked to stylar point; wings recurved.

Distribution. (Fig. 55) South West Western Australia: near the south coast, between Ravensthorpe and Israelite Bay.

Selected collections. ± 55 km E of Ravensthorpe, 28 Nov. 1978, *A. S. George* 15271 (AD, CANB, K, MEL, NSW, PERTH); 18 miles (25 km) N of Bedford Harbour, 2 Nov. 1962, *J. S. Beard* 2267 (PERTH); 13 miles (21 km) N of Esperance, 20 Oct. 1931, *W. E. Blackall* 1085 (PERTH); Wittenoom Hills, 4 Oct. 1968, *A. E. Orchard* 1367 (AD, PERTH); Cape Arid National Park, 13 Aug. 1980, *A. S. George* 16000 (PERTH); W. Australia, 30 Nov. 1848, *J. S. Roe* s.n. (K).

Habitat. In white sand or sandy loam, often at the margins of depressions, in open-heath, tall open shrubland or low open-woodland, the latter with *Eucalyptus occidentalis* or *Melaleuca cuticularis.*

Flowering period. Late October to January.

Although similar in its general appearance to *B. media* R.Br., *B. pilostylis* may be readily recognised by its leaves which have recurved margins and are more tomentose beneath, by its smaller inflorescences with very tightly packed flowers, by its pilose styles and by its large follicles and seeds. It also flowers at a different season. The species is fairly uniform, its most variable character being the length and indumentum of the involucral bracts.

At the late bud and early flowering stages the inflorescence has a very firm appearance, the perianths being more closely packed than in any other species. The open flowers produce a strong, mouse-like odour.

30. Banksia attenuata R.Br. (Figure 53)

Trans. Linn. Soc. London 10:209 (1810)—*Sirmuellera attenuata* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: prope littora. (ubi v.v.)" Holo: BM.

B. cylindrostachya Lindley, Sketch Veg. Swan Riv. Col. 34 (Jan. 1840). *Type citation:* none given. The material on which this work was based was collected by James Drummond and other early settlers at the Swan River Colony, Western Australia. Lecto (here chosen): CGE, a flowering specimen with the locality "Swan River Drummond" and annotated by Lindley as *cylindrostachya.*

Cotyledons spreading, obliquely cuneate, 16–20 mm long, 10–16 mm wide, broadly emarginate with one lobe longer than the other, faintly 3-nerved near base and reticulate above; auricles descending or spreading, acute, 1–2 mm long. *Hypocotyl* short, stout, glabrous. *Seedling leaves:* first 4–6 set closely above cotyledons, opposite or sub-opposite, then more scattered; broadly linear in outline but deeply serrate except for 1–2 cm at base, the 1st pair 2–3 cm long, 2nd pair 3·5–4 cm long, then up to 11 cm long, all 6–11 mm wide, acute or obtuse, mucronate; margins flat to slightly recurved, dentate; teeth (on the 1st leaves sometimes narrow and falcate) acutely mucronate, on the first leaves 2–4 mm long, on the upper ones 1–3 mm long, 2–8 mm wide; sinuses V- or U-shaped; upper surface loosely hirsute, lower with the midrib hirsute with long hairs and pubescent with shorter curled ones, the lamina woolly with matted white persistent hairs; venation ± reticulate, obscured. *Seedling stem* pubescent and hirsute with pale ferruginous hairs.

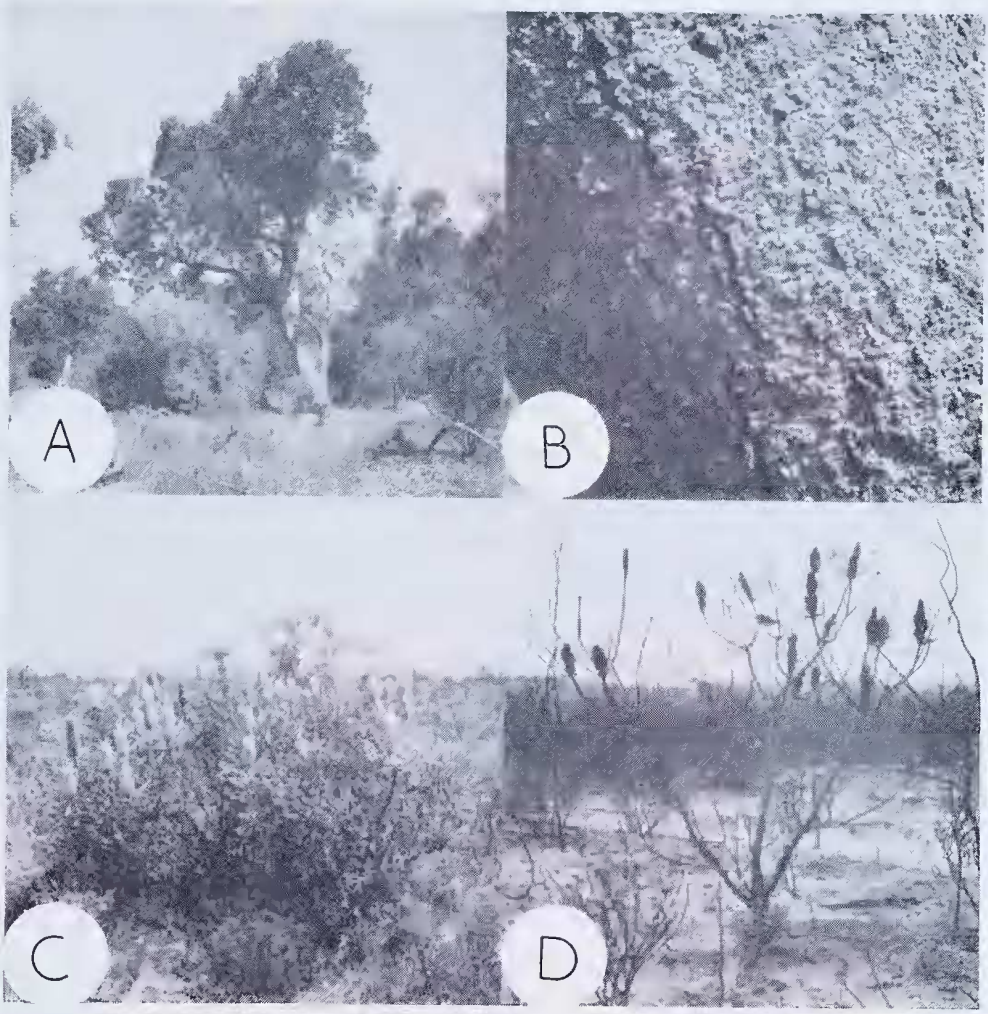


Figure 53. *Banksia attenuata*. A—Arborescent habit, 15 m tall. B—Bark. (Both Mandogalup, W.A.). C—Shrubby habit, 1·3 m tall (Near Arrowsmith R., W.A.). D—Regeneration from lignotuber after fire; burnt fruit with whorled branching habit (E of Jurien, W.A.).

Mature plant typically a tree to 10 m; north of Gingin often a shrub with several–many stems arising from a lignotuber and 1–2 m tall. *Trunk* stout, usually somewhat irregular; bark 1–2 cm thick, surface verrucose and friable, fibrous and red-brown beneath. *Branchlets* moderately stout, 5–8 mm thick; an involucre of bracts at the apex, the bracts subulate, 5–10 mm long, pubescent but viscid, mostly deciduous with the development of new growth but some carried up new branchlet with its elongation; branchlets pubescent with curled hairs and loosely hirsute with long ones, the latter deciduous; indumentum pale brown becoming grey. *Leaves* ± crowded, broadly linear, 4–27 cm long, 5–16 mm wide, truncate or retuse, obtusely mucronate; margins slightly recurved, serrate for most of length, the teeth obtuse, the distal side the shorter 0·5–2 mm long; sinuses shallow, obliquely V- or U-shaped; lamina hirsute above with straight and curled hairs becoming glabrous, midrib slightly impressed, densely hirsute below on midrib and lateral nervation with long and short pale brown hairs, lacunae white-woolly, midrib raised but ± flattened; petiole up to 1 cm long but lamina usually decurrent as narrow

ribs, base of petiole swollen; lateral nerves at 70°–90° to midrib often forking, reticulate between. *Inflorescence* cylindrical, terminal to a 1–3 year old branchlet, the new growth mostly occurring just after flowering. *Axis* 5–26 cm long, 5–8 mm wide, 14–18 mm wide with common bracts, bearing flowers throughout, sometimes except for 1 cm at base and apex. *Involucral bracts* numerous, subulate, 5–15 mm long, hirsute but viscid, persistent until flowering. *Common bracts* narrowly linear, 4·5–6 mm long, densely hirsute; exserted apex clavate, densely dark-ferruginous-pubescent, the extreme apex obtuse, almost black but with a tuft of long white hairs. *Floral bracts* similar but narrower, less clavate and not penicillate. *Flowers* green in bud becoming bright yellow throughout, including styles. *Perianth* 15–22 mm long including limb of 3–4·5 mm long; claws slender ± 0·5 mm wide above bracts tapering to 0·3 mm below limb, 3-nerved when dry, glabrous; limb narrowly elliptic to almost linear, keeled, often also 1-nerved each side, glabrous. *Anthers* 2 mm long, very shortly apiculate. *Pistil* 15–22 mm long, gently curved down then up, narrowed and ± quadrangular just below pollen-presenter, glabrous; pollen-presenter ± 1 mm long, cylindrical but swollen slightly at base, brown excepting the rounded apex and a band along the lower side, the apex ± laterally compressed, stigmatic groove lateral but longitudinal. *Infructescence* moderately massive, perianths and styles persistent, the styles after flowering curled against bracts. *Follicles* prominent, broadly elliptic in plan view, 2–3·5 cm long, 1·4–2 cm wide, 1–1·5 cm high; valves semi-elliptic, very convex, ± smooth but densely pubescent-hirsute, grey, often mottled with dark brown; suture fine; follicles often opening when mature, up to 2·5 cm across when open, somewhat expanded towards stylar side, the valves slightly recurved, deeply split from stylar point which then forms a concave beak; lips ± 1 mm wide, slightly broader at sides. *Seed* obovate, 22–26 mm long; seed body cuneate, 12–14 mm long, 13–14 mm wide, the lateral margins ± straight, narrowly winged, upper margin emarginate often unequally with a raised flange on inner face, base obtuse; inner face granular, dark brownish black, obscurely mottled; outer face sparsely rugose, brownish cream with grey margins, the rugosities dark brown; wing 15–18 mm wide, rounded, deeply notched on stylar side, inner face black with some grey mottling, outer face dark brown. *Separator* similar to seed in outline; a prominent flange on each side corresponding to that on seed body; wings split from stylar point which forms a broad beak.

Distribution. (Fig. 55) South West Western Australia: from Kalbarri to Cape Leeuwin and east almost to the Fitzgerald River, extending inland to Wongan Hills and Lake Grace.

Selected collections. Kalbarri National Park, Jan. 1969, *J. Bannister* s.n. (PERTH); Murchison R., no date, *Oldfield* s.n. (MEL); 10 km W of Lake Indoon, 7 Feb. 1977, *R. Hnatiuk* 770006 (PERTH); 35 km N of Gingin, 17 Mar. 1979, *T. J. Hawkeswood* 102 (PERTH); Watheroo Hills, 14 Jan. 1905, *A. Morrison* s.n. (CANB); Nedlands, 31 Oct. 1927, *C. T. White* 5171 (BRI); Dowerin, 24 Dec. 1959, *S. B. Rosier* s.n. (PERTH); 47 km E of Dumbleyung, 27 Nov. 1978, *A. S. George* 15266 (PERTH); Cape Naturaliste, Oct. 1909, *J. H. Maiden* s.n. (NSW); Bow River, Dec. 1912, *S. W. Jackson* s.n. (PERTH); Bremer Bay Road 15 miles (24 km) W of Bremer Bay, 1 Oct. 1966, *R. Filson* 9123 (MEL).

Habitat. In deep white, yellow, brown or pale red sand, sometimes over limestone or laterite, as a component of low woodland or low open-woodland (often with *B. menziesii* R.Br., *B. ilicifolia* R.Br., or *B. prionotes* Lindley), sometimes as an understorey tree to woodland of *Eucalyptus gomphocephala* DC. or *E. marginata* Donn ex Smith; in near-coastal situations often dominant; when shrubby, in tall shrubland, closed heath and open scrub.

Flowering period. October to February, with late flowers into May.

Banksia attenuata is a characteristic tree of sandy woodlands in near-coastal districts of the South West of Western Australia. It is often dominant, or co-dominant with such species as *B. menziesii*, *B. ilicifolia*, *Casuarina fraserana* and *Eucalyptus marginata*. It occurs also in scattered sandy pockets among the Jarrah forest on the Darling Plateau and for a short distance east of the forest. North of the Moore River its habitat becomes lower, and from the Hill River to the Murchison it is usually a mallee-like shrub with many stems arising from a lignotuber. In other respects, these plants are the same as the arborescent ones farther south and no formal infraspecific taxa can be recognised—a case similar to that seen in *B. menziesii* R.Br. In populations through the wheatbelt and

east of the Stirling Range the plants are usually stunted trees. Morphological variation in the species is seen mainly in the leaves which show a large range in length and width, and in the length of the inflorescence. The flowers have a "typical" *Banksia* scent. Arborescent forms are fire-tolerant, sprouting by epicormic shoots after a burn.

Although placed in the series *Cyrtostylis*, *B. attenuata* is anomalous in its large, emarginate cotyledons. In other respects, however, it shows relationships with *B. media* and *B. lindleyana*. It differs from *B. media* in being fire-tolerant, in its thick, friable bark, its narrower leaves with a different venation, its viscid branchlet and involucral bracts, its smaller, yellow flowers and its larger, smooth follicles. It is distinguished from *B. lindleyana* by its larger habit, its different leaf venation, its viscid bracts, its smaller flowers and larger follicles. The strong curling of the styles after flowering is an unusual characteristic of *attenuata*. In some species they become somewhat appressed to the axis but usually without curling, e.g. *B. praemorsa*, *B. marginata* (some variants). Dehiscence of the follicles in this species is irregular, occurring sometimes spontaneously when the follicles are mature, sometimes with fire.

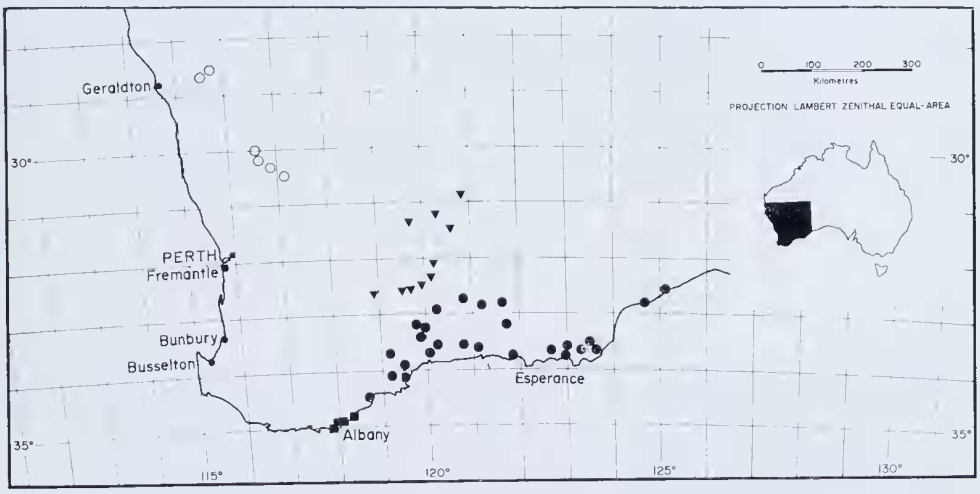


Figure 54. Distribution of *Banksia media* (●), *B. praemorsa* (■), *B. benthamiana* (○) and *B. audax* (▼).

31. **Banksia lindleyana** Meissner

Hook. J. Bot. & Kew Gard. Misc. 7:120 (1855)—*Sirmuellera lindleyana* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "*Drummond*, coll. vi. n. 204." Lecto: BM; iso: CGE, Fl, K (2 sheets), LD, MEL (3 sheets), P, U. There is no sheet at NY.

Seedlings not seen.

Mature plant a shrub to 3 m with lignotuber, rather openly branched, spreading. *Bark* somewhat fissured, not friable, grey. *Branchlets* slender, at first 1–2 mm thick, terete, closely tomentose, becoming glabrous after 1–2 years; a few terete, tomentose prophylls 5–10 mm long along base of branchlet. *Leaves* scattered, broadly linear, obtuse to truncate, shortly mucronate, 4–13 cm long, 4–12 mm wide; margins flat or very shortly recurved, serrate almost to base with obtuse teeth 0·5–2 mm long; sinuses shallowly U-shaped (occasionally V-shaped), 1–5 mm wide; lamina closely tomentose above with short curled hairs, pale brown, becoming glabrous; midrib below tomentose with ferruginous hairs becoming glabrous; lamina below with a few curled pale brown hairs on nerves becoming glabrous, woolly in lacunae; lateral nerves at 80°–90° to midrib, reticulate between; petiole 5–10 mm long, tomentose becoming ± glabrous. *Inflorescence* on short,

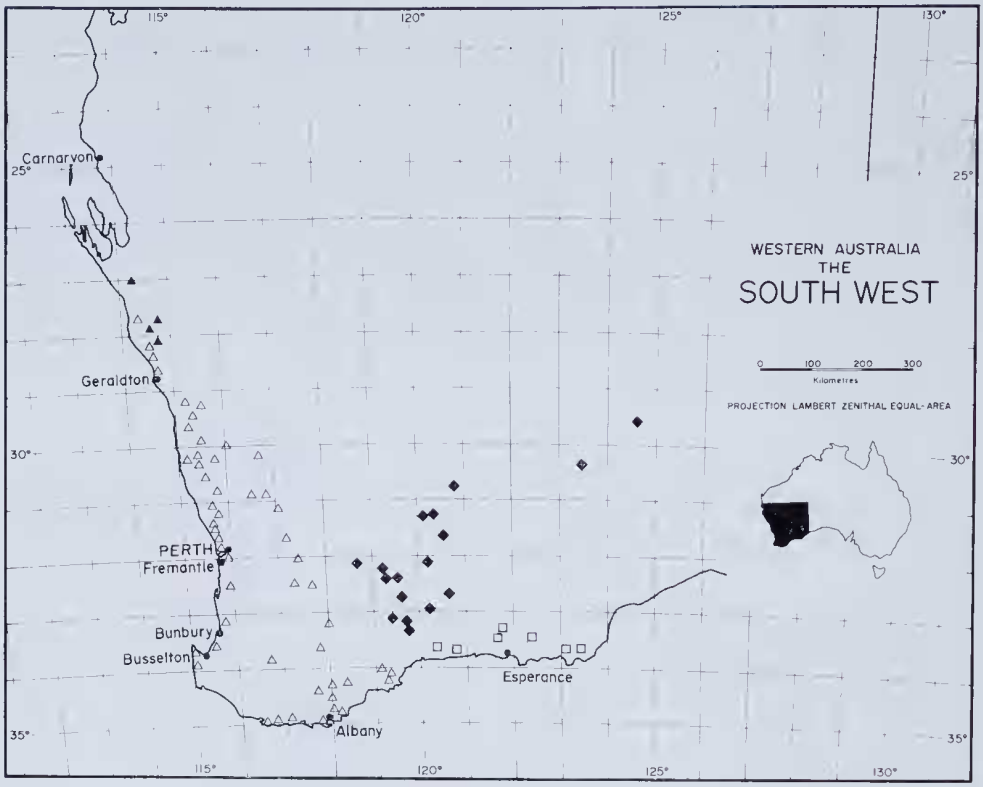


Figure 55. Distribution of *B. pilostylis* (□), *B. attenuata* (△), *B. lindleyana* (▲), and *B. elderana* (◆).

erect lateral branchlet from a stem 4–6 years old, sometimes terminal, cylindrical, 8–9 cm diam. at anthesis. *Axis* 5–9 cm long, 10–12 mm wide, 24–25 mm wide with common bracts, bearing flowers throughout except a few mm at base. *Involucral bracts* few, subulate from thick bases, 2–9 mm long, closely tomentose, brownish-cream, mostly deciduous before anthesis. *Common bracts* narrowly cuneate, 8–9 mm long, densely hirsute; exserted apex conical, slightly upturned, obtuse, tomentose, the hairs shorter and pale towards extreme apex but often with a small terminal tuft of longer hairs. *Floral bracts* narrower and shorter than common bracts, without exserted apices. *Flowers* yellow throughout, including styles. *Perianth* 35–43 mm long including limb of 9–10 mm, straight or slightly upturned before anthesis, not bent below limb; claws narrowly linear, 0·7 mm wide at base, tapering, quite glabrous on both sides; limb very narrowly fusiform, keeled, 1–2-nerved each side of keel, apex obtuse and straight or slightly incurved, glabrous or with a few short hairs at apex. *Anthers* 5 mm long on filaments of 1 mm, prominently apiculate. *Hypogynous scales* linear-oblong, obtuse, 2·5 mm long. *Pistil* 35–43 mm long, straight at first, somewhat bowed after anthesis, robust, sparsely hirsute in lowest third, glabrous above; tetragonal at apex; pollen-presenter 4–5 mm long, linear-terete, obtuse, finely costate, slightly swollen at base; stigmatic groove prominent, oblique; ovary pubescent at apex, otherwise glabrous. *Infructescence* ovoid; perianths persistent or deciduous, styles persistent, becoming rigid. *Follicles* up to 70, in plan view broadly elliptic, 15–20 mm long, 5–10 mm high, 8–12 mm wide; valves obliquely semi-elliptic, offset to stylar side, moderately thick, convex, smooth to slightly rugose, densely tomentose-hirsute becoming glabrous where exposed; ridge obtuse; suture fine, somewhat impressed; follicles opening usually with fire, to 15 mm, the valves split from stylar point leaving a beak; lips ± 1 mm wide, even. *Seed* narrowly obovate,

19–23 mm long; seed body ± narrowly obovate, 9–11 mm long, 3–4 mm wide, obtuse at base, lateral margins ± straight narrowly bordered; inner surface slightly concave to convex, smooth, black, somewhat glistening; outer surface convex, smooth, or 1-ridged, dark brown; wing 7–11 mm wide, curved towards stylar side where split leaving oblong lobe to stylar point, ± black, somewhat wrinkled. *Separator* similar to seed in shape and size, flattened-concave against seed body, thickened above but not overhanging, with thick beak to stylar point; wings recurved somewhat in upper 1/4.

Distribution. (Fig. 55) South West Western Australia: restricted to an area near the lower Murchison River and northwards towards Hamelin Pool.

Selected collections. Ca. 12 km WSW of Cooloomia homestead, 18 Sept. 1979, *S. D. Hopper* 1349 (PERTH); Murchison River, no date, *Oldfield* s.n. (MEL); N of Murchison R., 22 Sept. 1953, *N. H. Speck* 453 (CANB); 30 miles (48 km) W of (NW Coastal) Hwy. along Murchison R. (Kalbarri) road, 28 Jan. 1962, *A. S. George* 3232 (PERTH); near Binnu, March 1962, *F. Lullfitz* s.n. (PERTH).

Habitat. In deep yellow sand on plains and in swales, in tall open shrubland, sometimes associated with *B. sceptrum* and *B. ashbyi*.

Flowering period. January to March.

In its foliage, *B. lindleyana* shows a similarity to *B. attenuata* but may be easily distinguished by its larger flowers and its smaller follicles surrounded by spreading, rigid persistent styles. The pollen-presenter is much larger than that of *B. attenuata*, and is somewhat anomalous in the series.

The large, rather openly arranged flowers and the almost tetragonal limb (caused by the keels) are characters similar to those of the series *Tetragonae*. The long, finely costate pollen-presenter is also somewhat like that of the *Tetragonae* but it is not muricate. In other respects *B. lindleyana* diverges from that series.

The species appears to be uncommon. It is one of three summer-flowering *Banksias* in the region, the others being *B. sceptrum* and *B. victoriae*. Morphologically it is relatively uniform.

Figure 56. A—*Banksia ashybi*. Habit, ± 5 m tall (S of Shark Bay, W.A.). B—*B. elegans*. Habit, 3 m tall (Lake Indoon, W.A.).

32. Banksia ashbyi E. G. Baker (Figure 56A)

Journ. Bot. 72:281 (Oct. 1934).

Type citation: "WEST AUSTRALIA: Yuma (sic) Sand Plain, about 40 miles inland from Geraldton, *Edwin Ashby*. Albert Morris Herb. no. 2537." Lecto (here chosen): BM; iso: ADW 13520. "Yuma" should be Yuna.

Cotyledons (Fig. 8.28) obovate with upper margin oblique, spreading to recurved, 7 mm long, 4–6 mm wide, faintly reticulate, dull pale green; auricles slightly spreading, obtuse or acute, 1–2 mm long. *Hypocotyl* ± 1 cm long, slender, 1·5 mm wide, glabrous, green. *Seedling leaves* first 2 opposite, 2–3 mm above cotyledons, linear, acute, 16–17 mm long, 3–4 mm wide; margins flat, 2-serrate each side, the teeth 1–2 mm long, acute; upper surface and midrib below hirsute; lamina woolly below; next 2 leaves sub-opposite, narrowly obovate, 25–30 mm long, 7–11 mm wide, with 3–5 teeth per side up to 4 mm long; higher leaves scattered, narrowly obovate to broadly linear, acute, up to 10 cm long, 26 mm wide, deeply lobed, the lobes obliquely triangular, to 9 mm long, margins gently sigmoid, the distil margin often with a small secondary mucronate lobe; indumentum as in first 2 leaves, the upper surface often becoming ± glabrous; lamina tapering to base but sessile. *Seedling stem* hirsute and tomentose.

Mature plant a shrub or small tree to 8 m without lignotuber, usually erect and bushy but in coastal habitats low and spreading. *Bark* ± 0·5 mm thick, ± smooth, grey. *Branchlets* tomentose with curled pale brown hairs and shortly hirsute with spreading hairs, the former persistent for 1–2 years; prophylls on lower part of branchlet terete, upturned, 3–4 mm long, obtuse, closely tomentose with curled hairs. *Leaves* broadly linear, undulate, obtuse to acute, mucronate but mucro often deciduous, 10–30 cm long, 2–4 cm wide, serrate throughout except 1–5 cm at base; lobes triangular with concave margins, mostly 5–15 mm long, pungently acute, the apices not usually upturned; sinuses U-shaped or broadly V-shaped, up to 2·7 cm wide; sometimes a secondary lobe up to 3 mm long on distil margin of primary lobe; margins flat; lateral nerves at ± 90° to midrib but those to each lobe converging to its apex, finely reticulate between, scarcely evident on upper surface; both surfaces at first densely tomentose with pale ferruginous curled hairs, the midrib also with dense, straight hairs all over on upper surface and on margins only on lower, both surfaces becoming glabrous except lacunae of lower surface. Petiole ± terete, tomentose and shortly hirsute at first, later closely tomentose. *Inflorescence* cylindrical, terminating recent branchlet, not subtended by lateral branchlets at flowering, ± conspicuous, 6–8 cm wide; *axis* 6–15 cm long, 8–9 mm wide, 17–20 mm wide with common bracts, bearing flowers throughout except for 5–15 mm at base. *Involucral bracts* terete, scarcely thickened at base, 5–16 mm long, uncinate towards axis, closely tomentose, pale brown, mostly deciduous before anthesis. *Common bracts* oblong to narrowly cuneate, 4 mm long, densely ferruginous-hirsute; exserted apex very obtuse with a small upturned mucro, white-tomentose with short curled hairs. *Floral bracts* very similar, but exserted apex thicker, more conical, pale brown. *Flowers* bright orange throughout, including styles. *Perianth* 26–34 mm long including limb of 4–6 mm, ± straight but somewhat ascending, and limb upturned just before anthesis; claws 0·5 mm wide just above bracts, narrowing to 0·3 mm at base of limb, glabrous outside at base grading to appressed pubescent above, glabrous inside; limb narrowly fusiform, obtuse, appressed-tomentose. *Anthers* 2·5 mm long, obtusely apiculate; filament ± 0·5 mm long. *Hypogynous scales* broadly oblong, 1·5 mm long, irregularly lobed at apex, strongly cohering. *Pistil* 28–42 mm long, ± straight to gently sigmoid, exserted 5–8 mm above perianth after anthesis, glabrous, quadrangular just below pollen-presenter; pollen-presenter 2·5–3 mm long, terete, thicker than style, slightly swollen at base, obtuse, slightly ribbed; stigmatic groove slightly lateral at apex; ovary glabrous. *Infructescence* stout, 4–6 cm diam.; old perianths and styles becoming stiff and persistent for some years, eventually wearing off. *Follicles* numerous, elliptic to almost spherical in plan view, 8–15 mm long, 3–8 mm high, 5–11 mm wide; valves transversely elliptic, ± smooth; apex somewhat depressed but with raised obtuse ridge; suture very fine; closely tomentose, grey, follicles usually opening with fire, to 4–6 mm across, valves not recurved, shortly split on stylar side leaving an obtuse beak. *Seed* obovate-cuneate, 15–20 mm long; seed body 7–9 mm long, ± narrowly triangular with upper edge oblique; base obtuse; lateral margins acute to narrowly winged; inner surface ± concave, smooth to slightly rugose, black; outer surface with a convex ridge towards stylar side, smooth or slightly rugose, grey-brown, the margins ± recurved; wing 7–9 mm wide, upper half slightly curved to

stylar side which is shortly notched above seed body, dark brown. *Separator* similar to seed in outline, 14–20 mm long, 9–11 mm wide, base obtuse; wings shortly split on stylar side leaving a short, obtuse beak.

Distribution. (Fig. 57) Western Australia: near the central west coast and in the upper South West, from North West Cape to Quobba and from Hamelin Pool to Coorow, near the southern end of its range extending inland almost to Mullewa; also a disjunct outlier in the Kennedy Range east of Carnarvon.

Selected collections. North West Cape, 31 Dec. 1960, *A. S. George* 2299 (PERTH); Near lighthouse, Point Quobba, 28 July 1929, *R. A. Saffrey* 668 (PERTH); Peron Peninsula, 27 Aug. 1931, *C. A. Gardner* 2552 (PERTH); NW Coastal Hwy., 31 miles (45 km) N of Murchison R. Bridge, 6 Sept. 1966, *R. Filson* 8605 (MEL); S of Mullewa, 20 Sept. 1952, *N. H. Speck* (CANB); Coorow, Feb. 1940, *C. A. Gardner* s.n. (PERTH); Top of Kennedy Range, E of Carnarvon, May 1971, *M. K. Morcombe* s.n. (PERTH).

Habitat. In deep red sand on plains and low dunes, in tall shrubland or open shrubland; north of Carnarvon on coastal dunes; on the Cape Range and the Kennedy Range on red sand dunes.

Flowering period. Chiefly winter, but flowers have been recorded at all seasons.

Baker (1934) considered *B. ashbyi* to be related to *B. victoriae* Meissner but in doing so placed too much weight on the orange flowers and long triangular-lobed leaves. The species is more closely allied to species of the *Cyrtostylis* and in particular to *B. benthamiana* C. Gardner, a species unknown to Baker. It differs from that species in the larger habit, the smooth bark, the larger, more deeply lobed leaves, the longer, brighter flowers, the wider follicles and the narrower seeds.

The species is rather variable in habit. South of Shark Bay it is usually an erect shrub, sometimes a small tree, while north of Carnarvon it is a low, spreading shrub, probably an effect of the coastal habitat. Size of leaves, flowers and fruit is also variable. The flowers, of a brighter orange than any other species, produce a sweet "*Banksia*" scent. Flowering is somewhat irregular, probably because over much of its range the rainfall is unreliable.

Banksia ashbyi is noteworthy as the only species of the genus in temperate Western Australia to extend north of the South West Botanical Province (Beard, 1980). It is fairly common on coastal dunes from Quobba to North West Cape and on a few dunes of the Cape Range, this region receiving a low winter rainfall. A number of other South Western plants also extend to the region, e.g. *Acanthocarpus preissii*, *Hibbertia spicata* and *Melaleuca cardiophylla* (Erickson et al., 1973). The disjunct outlier on the Kennedy Range east of Carnarvon is less easily explained since it lies in a region of low, unreliable rainfall. *Banksias* have occurred in the Kennedy Range for some time, however, though recently discovered fossil fruit impressions (Anon., 1980) resemble very closely present-day *B. attenuata* which now occurs no nearer the Range than Kalbarri National Park, some 300 km to the south west.

33. Banksia benthamiana C. Gardner

J. Roy Soc. W. Austral. 47:57 (13 July 1964).

Type citation: "Hab. in distr. Austin ad Dalwallinu ad Lacum Monger, attingit et prope oppidulum Wilroy, in arenoso glareosis, fl.m. Decembri-Januario. prope Wubin *Gardner* 12097; Wilroy *Gardner* 12075 (TYPUS)." Lecto (here chosen): Dalwallinu, Jan. 1940, *C. A. Gardner* s.n. (PERTH)—annotated by Gardner "Banksia Benthamiana C. A. Gardner" and labelled by him "Type Specimen". Isolecto: PERTH. Syn: Rabbit Proof Fence E. from Perenjori, 24 Nov. 1953, *C. A. Gardner* 12097 (AD, CANB, K, MEL, NSW, PERTH). No sheet of Gardner 12075 has been found.

Cotyledons (Fig. 8.29) obovate, 9–10 mm long, 4 mm wide, ascending, 3-nerved, dull green; upper margin somewhat crenulate-undulate; auricles spreading, acute, 1·5 mm long. *Hypocotyl* ± 1 cm long, 1·5 mm thick, glabrous, pink. *Seedling leaves* crowded, immediately above cotyledons; first 2 narrowly obovate, obtuse, 9–10 mm long, 2 mm wide; margins gently recurved, very shortly and obtusely 1-lobed each side near apex; lamina loosely hirsute above and on nerves below, lacunae below very loosely

woolly; next 2–4 leaves narrowly obovate-cuneate, 15–25 mm long, 5–10 mm wide, acutely dentate each side with 1–3 triangular lobes 1–2 mm long; indumentum as in first leaves to 7 cm long, 25 mm wide, margins flat, acutely dentate, the teeth to 5 mm long. *Seedling stem* densely tomentose and hirsute.

Mature plant a shrub to 4 m tall without lignotuber, much-branched and bushy. *Trunk* stout at base. *Bark* roughly flaking, grey. *Branchlets* terete, slightly striate, at first ± 3 mm wide, closely and densely tomentose with curled hairs, ferruginous, becoming grey; indumentum wearing off after 2–3 years; bracts near base subulate, closely tomentose, 5–12 mm long; most axils producing short lateral leafy branchlets in second year. *Leaves* scattered, linear, acute, mucronate, mostly 10–25 cm long, 5–10 mm wide; margins flat, shortly serrate for 1/2 to 3/4 of length (sometimes entire), the teeth obtuse to acute, often upturned, rigid, 1–2 mm long; sinuses broadly and shallowly U-shaped, mostly 5–20 mm wide; upper surface densely pubescent with short curled hairs, more densely along midrib, becoming glabrous; lower surface with midrib and lateral nerves tomentose, the hairs longer on each side of midrib, becoming glabrous; lacunae very small, white-woolly; lateral nerves fine, reticulate between; lamina tapering, the petiole 5–15 mm long, closely pubescent. *Inflorescence* on short, lateral leafy branchlet from older stem, cylindrical-ovoid, 6 cm wide at anthesis. *Axis* 5–10 cm long, 9–10 mm wide, 18–19 mm wide with common bracts, bearing flowers throughout. *Involucral bracts* numerous, subulate on thick bases, 5–10 mm long, tomentose to shortly hirsute, the outer ones grey, inner ferruginous, persistent until anthesis. *Common bracts* linear, 4·5–5 mm long, densely hirsute; exserted apex shortly conical, tomentose and often penicillate, ferruginous with pale brown extreme apex. *Floral bracts* narrower, shorter, with small apex. *Flowers* golden orange to orange-brown throughout. *Perianth* 20–24 mm long, including limb of 4–5 mm, straight with limb gently upturned before anthesis; claws ± 0·5 mm wide above base, pubescent outside with the hairs becoming longer and denser towards limb, loosely hirsute inside along margin; limb narrowly fusiform but widest above middle, obtuse, keeled, 1-nerved on each side, sparsely appressed-hirsute with the nerves and keel often ± glabrous. *Anthers* ± 2 mm long on filaments of 1 mm, shortly apiculate. *Hypogynous scales* linear, acute or obtuse, 1·5–2·5 mm long. *Pistil* 23–26 mm long, gently curved down then outwards, glabrous; pollen-presenter 1·5 mm long, narrowly fusiform, obtuse, finely costate; stigmatic groove oblique; ovary hirsute in upper half, especially on lower side, otherwise glabrous. *Infructescence* ovoid, 5–6 cm diam.; old perianths and styles persistent, at length wearing away leaving follicles shortly exposed. *Follicles* up to about 130, in plan view narrowly elliptic, 10–15 mm long, 3–5 mm high, 3–5 mm wide; valves semi-elliptic, slightly expanded on stylar side, shallowly convex, smooth, tomentose to shortly hirsute, the hairs wearing off exposed parts; ridge obtuse; suture very fine; follicles usually opening with fire, to 13 mm across, valves gently recurved, split from stylar point leaving a beak; lips 0·5 mm wide, even. *Seeds* obovate 17–19 mm long; seed body ± cuneate, 7–8 mm long, 4–5 mm wide, acute at base, the upper margin convex, somewhat oblique; lateral margins ± straight, very narrowly bordered; inner face convex, smooth or with very slight short ridges, black, slightly glistening; outer face convex, acutely rugose, brown, somewhat shining; wing 10–12 mm wide, curved to stylar side where split leaving a small obtuse secondary lobe. *Separator* similar to seed in shape and size, concave and thin against seed body, thickened above with a slightly overhanging ridge, a broad beak to stylar point; wings recurved.

Distribution. (Fig. 54) South West Western Australia: between Mullewa and Kulja.

Selected collections. Pindar, 20 Dec. 1962, *F. Lullfitz* 1999 (PERTH); 16 km SSE of Mullewa, 4 June 1977, *B. G. Muir* 348 (3·17) (PERTH); Buntine, 23 Dec. 1959, *M. C. George* s.n. (PERTH); 2 miles (3 km) ENE of Kulja, 13 Nov. 1971, *A. S. George* 11177 (BRI, CANB, K, NSW, PERTH).

Habitat. In brownish-yellow sandy loam or clay-loam, sometimes over laterite, on plains in tall shrubland of *Acacia* and *Casuarina*.

Flowering period. Late November to January.

Banksia benthamiana is related on the one hand to *B. ashbyi* and on the other to *B. elderana* and *B. hullfitzii*. Its distinguishing charactersitics are the bushy, non-lignotuberous habit, rough bark, linear leaves 10–25 cm long with short teeth, cylindrical-ovoid inflorescences, dull orange flowers and pubescent perianths. Although found over

a large area near the boundary of the South West and Eremean Botanical Provinces, the species is known to be common in only a few localities. It is morphologically uniform.

Banksia ashbyi, which occurs to the west and north west of *benthamiana*, is usually a larger plant with smooth bark, longer triangular-lobed leaves, bright orange closely silky flowers in longer, terminal inflorescences, and usually smaller follicles. Both *B. elderana* and *B. lullfitzii* have lignotubers, rough bark and very long, harshly dentate leaves. The former has pendent inflorescences, yellow flowers and a glabrous perianth limb, while the latter has erect inflorescences, orange-brown flowers and large, tomentose perianths. *Banksia audax* is also related to *B. benthamiana* but has a lignotuber and is smaller in all respects.

34. Banksia audax C. Gardner

J. Roy. Soc. W. Austral. 13:63 (24 Oct. 1928).

Type citation: "Hab. in Distr. Coolgardie, in arenosis aridis apertis prope Bronti, flor. m. Decem. (C. A. Gardner, Dec. 1926)." Holo: PERTH; iso: CANB, K, MEL 52571, PERTH. The holotype was collected on 7 December 1926, and the isotype at PERTH is dated 14 Dec. 1926.

Cotyledons (Fig. 8.30) orbicular-obovate, spreading to recurved, 6–10 mm long, 5–8 mm wide, faintly reticulate, medium green; upper margin slightly crenulate; auricles descending, acute, 1·5 mm long. *Hypocotyl* ± slender, glabrous, red. *Seedling leaves* crowded above cotyledons; first 2 narrowly obovate-cuneate, obtuse, 13–18 mm long, 3–5 mm wide; margins slightly recurved, entire or 1-dentate, the teeth triangular, acute, 2 mm long; upper surface hirsute with white hairs, lower surface hirsute on nerves, loosely woolly between; lamina tapering to base; higher leaves obovate, up to 5 cm long, 2 cm wide, obtuse but mucronate, acutely dentate with teeth up to 4 mm long; indumentum as in first leaves but midrib below densely hirsute. *Seedling stem* tomentose and hirsute.

Mature plant a shrub to 1 m with lignotuber, rather openly branched. *Bark* fissured, grey. *Branchlets* terete or slightly angular, 1·5–2 mm thick at first, densely tomentose and loosely hirsute, ferruginous, becoming closely tomentose then glabrous after 2–4 years, grey; prophylls at base narrowly linear, acute, 4–7 mm long, tomentose. *Leaves* scattered, narrowly cuneate, truncate, mucronate, 2–7 cm long, 8–20 mm wide, ± concave, often undulate; margins flat, serrate to dentate almost to base, sometimes only in upper 1/2–2/3, the teeth triangular, often oblique, pungently acute, 1–3 mm long, margins concave; sinuses shallowly U-shaped, rarely V-shaped, 2–10 mm wide; lamina hirsute and tomentose above becoming glabrous, densely hirsute and tomentose below on midrib becoming glabrous, reticulum on lamina tomentose becoming glabrous, finely woolly in lacunae; midrib not raised; lamina tapering to base, the petiole less than 10 mm long, tomentose. *Inflorescence* erect, on short, leafless or leafy lateral branchlet from older stem, ovoid-cylindrical, 5–5·5 cm diam. at anthesis. *Axis* 3–5 cm long, 6–7 mm wide, 14–15 mm wide with common bracts, bearing flowers except for a few mm at base. *Involucral bracts* ± numerous, subulate on thick bases, 2–8 mm long, tomentose and loosely hirsute, pale brown. *Common bracts* linear, 4–4·5 mm long, hirsute; exserted apex narrowly conical, straight, acute, densely tomentose and penicillate. *Floral bracts* shorter, without an exserted apex. *Flowers* mostly golden orange throughout including styles, those at apex of inflorescence usually ferruginous. *Perianth* 20–23 mm long including limb of 3·5–4 mm, ± straight or gently curved, the limb upturned before anthesis; claws filiform, 0·5 mm wide at base, pubescent outside with curled or wavy hairs, glabrous inside; limb narrowly fusiform but widest in upper half, almost acute, densely hirsute outside; indumentum of uppermost flowers in inflorescence longer and darker. *Anthers* 1·5 mm long on filaments of 0·5 mm, shortly apiculate. *Hypogynous scales* linear but tapering, obtuse, 1·5 mm long. *Pistil* 19–23 mm long, curved gently down then up, slender, glabrous; pollen-presenter linear-terete, 1 mm long, obtuse, smooth or slightly costate; stigmatic groove oblique; ovary long-hirsute at apex, otherwise glabrous. *Infructescence* small, 4–6 cm diam.; old perianths and styles persistent, gradually wearing away. *Follicles* up to 40, not prominent, in plan view elliptic, 8–13 mm long, 4–5 mm high, 4–6 mm thick; valves semi-elliptic, evenly curved or slightly expanded on stylar

side, convex, smooth, densely hirsute and tomentose, the indumentum gradually wearing away; ridge obtuse; suture inconspicuous; follicles opening usually with fire, to 14 mm across; valves split from stylar point leaving a beak; lips ± 1 mm wide, even. *Seeds* obovate, 18–22 mm long; seed body cuneate-obovate, acute at base, 10–12 mm long, 6–8 mm wide; lateral margins slightly convex, narrowly bordered; upper margin convex, thickened; inner face ± flat, smooth or slightly wrinkled, black, glistening; outer face convex, smoothly rugose, brown with some gold markings, shining; wing 9–12 mm wide, curved to stylar side where split leaving small obtuse secondary lobe. *Separator* similar to seed in shape and size, flat and thin against nucellus, thickened above, somewhat overhanging, with a short beak to stylar point; wings recurved.

Distribution. (Fig. 54) South West Western Australia: central south, between Southern Cross, Pingaring, the Johnston Lakes and Bullabulling.

Selected collections. Bronti, 242 miles (± 390 km) E of Perth, 5 Aug. 1952, *R. Melville & C. A. Gardner* s.n. (K, MEL); 42 miles (± 65 km) E of Hyden, 14 Oct. 1963, *K. Newbey* 1141 (PERTH); E of Kulin, 10 May 1979, *K. Wallace* s.n. (PERTH); ± 130 km SE of Southern Cross, 14 March 1978, *A. S. George* s.n. (PERTH).

Habitat. In yellow sandy loam sometimes with gravel, in open heath.

Flowering period. November to January.

Banksia audax is easily recognised among the *Cyrtostylis* by its small habit, leaves, flowers and fruit. The species is consistent, variation appearing mainly in the size of the leaves. Although fairly common over much of its range it is relatively inconspicuous and, flowering in early summer, is not often collected in flower. It is related to *B. benthamiana* (q.v.) and *B. laevigata*, the latter being a larger shrub without lignotuber, longer leaves, spherical inflorescences with closely packed, fine flowers that are yellow and brown or creamy-grey.

Although named by Gardner for its "boldness" in growing so far inland, the species is sympatric with *B. elderana* over most of its range, and the latter species has outlying populations farther east on the desert margin.

35. Banksia laevigata Meissner

In DC., Prodr. 14:458 (Oct. 1856)—Published as a nomen nudum in Hook. J. Bot. & Kew Gard. Misc. 4:210 (1852)—*Sirmuellera laevigata* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In colonia Swan River (Drumm. coll. 5, n. 414!)." Lecto (here chosen): NY; iso: B, BM, FI, G, K (3 sheets), MEL, NSW, P.

Cotyledons cuneate-obovate, spreading, 7–10 mm long, 5–6 mm wide, ± nerveless, medium green; upper margin slightly crenulate, sometimes reddish; auricles descending, obtuse, 1·5 mm long. *Hypocotyl* 1–1·5 cm long, slender, 1 mm diam., glabrous. *Seedling leaves*: first 2 immediately above cotyledons, narrowly cuneate, obtuse, 13–17 mm long, 3–5 mm wide, 1-lobed on each side near apex, the lobes triangular, obtuse to acute, 1·5 mm long; margins slightly recurved; lamina hirsute above; hirsute on nerves below and loosely woolly in lacunae; reticulum open; next 2 leaves close above first, similar to them but up to 20 mm long, sometimes the margins 2-lobed; higher leaves more scattered, cuneate to narrowly obovate, 2–5 cm long, 7–18 mm wide, obtuse but shortly mucronate; margins almost flat, acutely serrate for 1/2 –3/4 of length, the teeth up to 3·5 mm long; indumentum as in first leaves, but reticulum on lower surface becoming finer with denser wool. *Seedling stem* long-hirsute and tomentose.

Mature plant a shrub to 3·5 m without lignotuber, usually rather openly branched and erect, sometimes bushy. *Trunk* to 10 cm diam. *Bark* roughly flaked, grey. *Branchlets* terete, somewhat striate, at first 3 mm diam., densely tomentose to hirsute, ferruginous, the indumentum turning grey, wearing off after 2–3 years, prophylls at base subulate, 8–18 mm long, hirsute-plumose; short lateral leafy branchlets often developing. *Leaves* scattered, narrowly cuneate to broadly linear, acute or truncate, mucronate, 5–14 mm long, 4–20 mm wide; margins flat to slightly recurved, serrate sometimes to base, sometimes only in upper 1/2, sometimes almost entire; teeth obtuse to mucronate, 1–3 mm long; sinuses obliquely U- or V- shaped, mostly 3–10 mm wide; lamina hirsute above and

on nerves below, more densely on midrib becoming glabrous; lacunae very small, white-woolly; lamina tapering to petiole of 5–10 mm. *Inflorescence* on short, lateral usually leafy branchlet from an older stem, occasionally terminal to main branchlet, spherical, 8–10 cm diam. at anthesis. *Axis* obovoid to ovoid, 2–3 cm long, 10–12 mm diam., 20–23 mm diam. with common bracts (excluding awns), bearing flowers throughout. *Involucral bracts* numerous, subulate on thick bases, 5–15 mm long, villous and tomentose, the outer ones grey, inner ferruginous, persisting until anthesis. *Common bracts* linear, ± 5 mm long, produced into filiform awns of 5–7 mm, hirsute to apex, ferruginous. *Floral bracts* narrowly linear, ± 4 mm long, not awned, hirsute. *Flowers* pale yellow with greyish indumentum throughout (var. *laevigata*) or with ferruginous claws and yellow limbs (var. *fuscolutea*); styles cream to pale yellow. *Perianth* 20–26 mm long including limb of 3–3·5 mm, the limb upturned before anthesis; claws filiform, 0·3 mm wide above base, hirsute outside, the hairs more crowded towards limb, sparsely hirsute inside along margins; limb narrowly fusiform but widest above middle, almost acute, in var. *laevigata* densely hirsute outside, the hairs longest at apex, in var. *fuscolutea* glabrous. *Anthers* 1·2–1·5 mm on filaments of 0·7 mm, apiculate. *Hypogynous scales* narrowly linear, obtuse, almost 2 mm long. *Pistil* 30–32 mm long, very slender, curved gently down then up, glabrous; pollen-presenter not or only slightly thickened, obtuse, 0·7–1·4 mm long, very finely costate; stigmatic groove oblique; ovary long-hirsute about apex, otherwise glabrous. *Infructescence* spherical, 5–6 cm diam.; old perianths and styles persistent. *Follicles* up to about 100, in plan view broadly linear to narrowly elliptic, 10–18 mm long, 3–7 mm high, 4–7 mm wide; valves semi-elliptic, slightly enlarged on stylar side, gently convex, smooth to finely rugose, tomentose-villous, the hairs wearing off exposed parts; ridge obtuse to rounded; suture very fine; follicles usually opening with fire, to 15 mm across, valves somewhat recurved, split from stylar point leaving a beak; lips 0·5 mm wide, even. *Seed* narrowly obovate, 12–18 mm long; seed body ± cuneate-obovate, acute at base, 7–8 mm long, 3–4 mm wide, the upper margin thickened, oblique, lateral margins ± straight, narrowly flanged; inner surface convex, rugose to slightly wrinkled, black, slightly glistening; outer surface convex, sparsely rugose, brown; wing 6–10 mm wide, upper half curved to stylar side and there deeply notched, leaving short obtuse lateral lobe; dark brown. *Separator* similar to seed in shape and size, impressed and rather thin against seed body, thickened above, with a thick obtuse beak to stylar point; wings recurved in upper third, rather thin.

Banksia laevigata is easily recognised by its non-lignotuberous, erect habit, its broadly linear to narrowly cuneate, shortly dentate leaves, its spherical inflorescence, its awned common bracts and its tightly packed small follicles. The spherical inflorescence is noteworthy, for among the section *Banksia* only one other species has this character, viz. *B. elegans*, and in that the flowers are openly arranged. The fine, closely packed flowers of *laevigata* produce a ball-like effect. There are two subspecies which differ strikingly in the indumentum of the perianth limb and the flower colour. They also have somewhat different flowering periods and are geographically disjunct.

35A. B. laevigata Meissner subsp. **laevigata**

Flowers pale lemon yellow with grey indumentum. *Perianth* hirsute including limb.

Distribution. (Fig. 57) South West Western Australia: lower Fitzgerald River and the Ravensthorpe Range.

Selected collections. E side of Fitzgerald R. valley above Roes Rock, 18 Dec. 1970, *A. S. George* 10553 (NSW, PERTH); Mt. Desmond (SE of Ravensthorpe), 27 Oct. 1963, *T. E. H. Aplin* 2693b (PERTH); Ravensthorpe Range, S of pass on Esperance road, 14 Oct. 1960, *A. S. George* 1634 (PERTH).

Habitat. In rocky soil (spongolite, laterite) usually on hills and on top of breakaways, in tall shrubland and low open-woodland.

Flowering period. October to December.

This variety shows some variation between the Fitzgerald River populations and those of the Ravensthorpe Range. The former have tomentose to shortly hirsute young branchlets, leaves mostly 5–11 cm long with obtuse teeth up to 1·5 mm long, and perianths 20–23 mm long. The latter have hirsute young branchlets, leaves mostly 8–13 cm long

with acute teeth 1·5–2·5 mm long, and perianths 25–26 mm long. In other respects they are uniform, however, and I do not consider them worthy of formal infraspecific rank. The Fitzgerald River variant is represented by the type collection.

35B. B. laevigata subsp. **fuscolutea** A. S. George

W. Aust. Naturalist 10:32 (22 Feb. 1966).

Type citation: "17 miles E. of Hyden, A. S. George 6053, Jan. 1, 1964". Holo: PERTH; iso: K, MEL, PERTH.

Flowers bright yellow with ferruginous indumentum. *Perianth* hirsute on claws; limb glabrous.

Distribution. (Fig. 57) South West Western Australia: between Barker Lake, Hyden, Frank Hann National Park and Mt. Day.

Selected collections. SE of Southern Cross, 14 March 1978, *A. S. George* s.n. (PERTH); Lake Cronin, early Dec. 1963, *C. F. Davies* s.n. (PERTH); Frank Hann National Park, 2 Aug. 1978, *D. Monk* 082 (PERTH); 305 mile peg, Norseman-Hyden road (± 160 km E of Hyden) Dec. 1956, *R. J. Donovan* s.n. (PERTH); Kumarl-Lake King Rd, 50 miles (80 km) W of Kumarl, 10 Oct. 1966, *R. Filson* 9344 (MEL).

Habitat. In yellow or light brown sand or sandy loam, sometimes with laterite, on plains in tall open-shrubland.

Flowering period. December to February.

The bright colours of the perianth, heightened by the lack of indumentum on the limb, give the subspecies an inflorescence much more conspicuous than that of the subsp. *laevigata*. The differences and the subspecies itself are consistent. In foliage subsp. *fuscolutea* is like the variant of subsp. *laevigata* from the Ravensthorpe Range.

Although elsewhere in this paper I have used only the category *variety* for infraspecific taxa, I have retained *subspecies* for this taxon, as published in 1963, partly for the subjective reason that to change it to variety would result in an awkward author citation. It does, however, conform to a widely accepted concept of a subspecies in being geographically isolated from subsp. *laevigata*.

36. Banksia lullfitzii C. Gardner

W. Aust. Naturalist 10:68 (13 July 1966).

Type citation: "Hb. in distr. Coolgardie prope Koorarawalyee, in campis arenosis apertis, fl. m. Feb. Mart., *Gardner* 16411, TYPUS: etiam haud procul Southern Cross in acacietis lutosis." Holo: PERTH, Gardner 16411. The sheet bears a typed Gardner label with the locality "inter Yellowdine et Boorabbin Mart. 1966". This locality is east of Southern Cross.

Cotyledons (Fig. 8.31) obovate-cuneate, spreading, 13 mm long, 11–12 mm wide, 3-nerved to reticulate, medium green, ± shining; auricles descending, 2 mm long, ± obtuse. *Hypocotyl* 1 cm long, 1·5 mm thick, glabrous, red. *Seedling leaves* crowded above cotyledons; first 2 narrowly obovate, acute or obtuse, 22–23 mm long, 10–14 mm wide; margins slightly recurved, divided on each side into 2–4 triangular acute lobes 2–5 mm long; upper surface hirsute, lower surface hirsute on nerves, loosely woolly between; lamina tapering to base; higher leaves becoming broadly linear, to 10 or more cm long, 17 mm wide, serrate to base, the teeth mucronate; indumentum as in first leaves, but wool in lacunae of lower surface becoming more compact and the lacunae smaller. *Seedling stem* hirsute.

Mature plant a shrub to 1·5 m tall with lignotuber, much-branched and somewhat sprawling. *Bark* exfoliating in flakes, grey on surface, brown beneath. *Branchlets* terete with slight ribs below leaf bases, at first 3–5 mm wide, densely tomentose, ferruginous becoming closely tomentose and grey; glabrous after 2–3 years: prophylls only at base of branchlet, linear-terete, 3–12 mm long, densely tomentose. *Leaves* linear, usually flexuose, acute, pungent, mostly 20–45 cm long, 8–18 mm wide; margins flat, divided for much of length into obliquely triangular rigid pungent lobes 2–7 mm long; sinuses broadly U-shaped, ± angular at lower corner, motsly 1–2 cm wide; lamina tomentose and hirsute

above, more densely so along midrib, becoming glabrous, hirsute and tomentose on midrib below, the reticulum closely tomentose with curled hairs, all becoming glabrous leaving wool in the laeunae; lobes 3-nerved and prominently reticulate; lamina tapering gradually to petiole. *Inflorescence* erect, on very short leafless or few-leaved branchlet lateral to an old stem, broadly ovoid-cylindrical, 8–10 cm diam. at anthesis. *Axis* 4–13 cm long, 5–6 mm wide, 20–24 mm wide with common bracts, bearing flowers throughout except a few mm at base. *Involucral bracts* linear-terete on thick bases, 5–13 mm long, densely tomentose, the outer ones acute, grey, inner ones obtuse, brown. *Common bracts* narrowly cuneate, 8–9 mm long, densely hirsute; exserted apex conical, somewhat upturned, obtuse, densely tomentose and shortly penicillate, pale brown. *Floral bracts* slightly shorter, narrower, with small rounded apex. *Flowers* golden orange to orange-brown throughout, including styles. *Perianth* 34–49 mm long including limb of 5–6 mm, straight to gently curved, the limb upturned before anthesis; claws slender 0·6 mm wide above base, tomentose outside with curled hairs, glabrous inside; limb narrowly elliptic, almost acute, densely woolly with curled hairs. *Anthers* 2·5 mm long on filaments of 0·5 mm, apiculate. *Hypogynous scales* broadly oblong, obtuse or emarginate, 1·5 mm long. *Pistil* 33–48 mm long, gently curved, appressed-pubescent above ovary with more sparse hairs above, the upper 3/4 glabrous; pollen-presenter narrowly fusiform, 2·5 mm long, obtuse, finely costate; stigmatic groove oblique; ovary densely tomentose in upper half. *Infructescence* moderately stout; old perianths and styles persistent, the latter becoming rigid. *Follicles* ± hidden, up to 30, in plan view elliptic, 15–25 mm long, 8–12 mm high, 8–10 mm wide; valves broadly semi-elliptic, somewhat expanded on stylar side, convex, smooth, densely tomentose-hirsute; ridge very obtuse; suture fine; follicles opening with fire, to 16 mm across; valves split from stylar point leaving a beak; lips 1 mm wide. *Seeds* obovate,

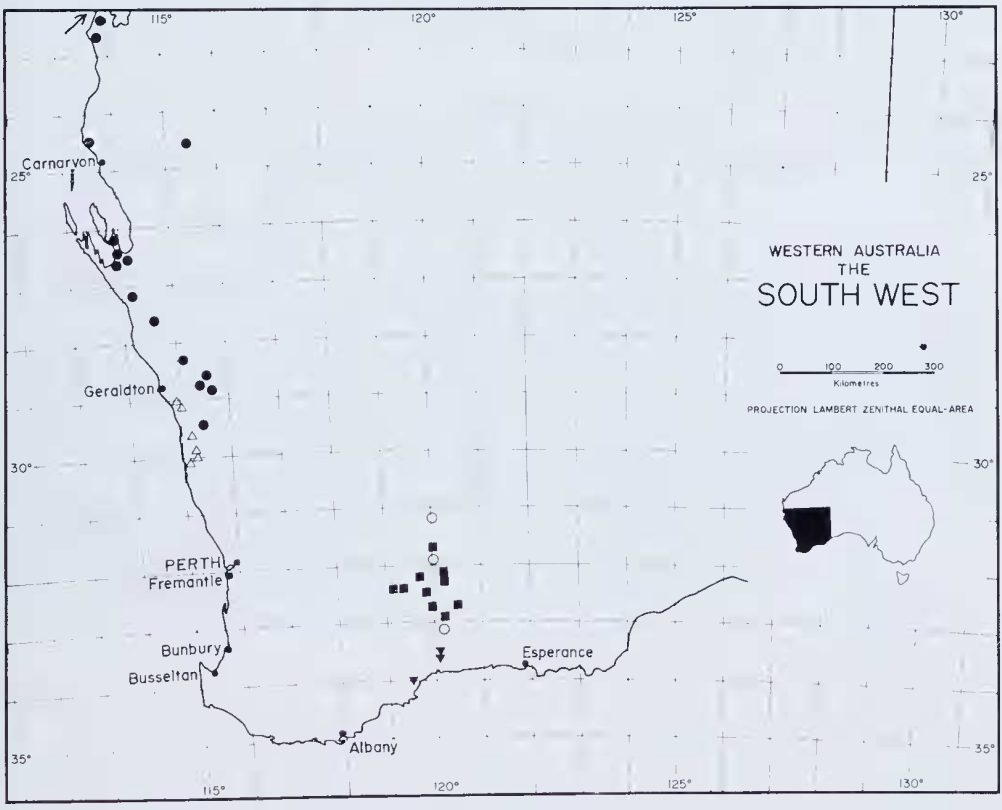


Figure 57. Distribution of *Banksia ashbyi* (●), *B. laevigata* subsp. *laevigata* (▼), *B. laevigata* subsp. *fuscolutea* (■), *B. lullfitzii* (○), and *B. elegans* (△).

20–23 mm long; seed body cuneate, almost acute at base, 7–10 mm long, 8–19 mm wide, lateral margins straight to slightly convex, very narrowly bordered, upper margin convex, thickened; inner face slightly convex, smooth, black, glistening; outer face convex, ± rugose with ridges, sometimes ruptured, dark grey to black, shining; wing 15–18 mm wide, curved to stylar side, where split leaving an obtuse secondary lobe. *Separator* similar to seed in shape and size, flat and smooth against seed body, a thickened overhanging ridge above, a broad beak to stylar point; wings recurved.

Distribution. (Fig. 57) South West Western Australia: central south, between Southern Cross, Coolgardie and Ravensthorpe; few populations known.

Selected collections. Koorarawalyee, 16 May 1966, *C. F. Davies* s.n. (PERTH); 52 km S of Duri, ca. 100 km SE of Southern Cross, 23 Sept. 1979, *K. Newbey* 6083 (PERTH); No. 1 Rabbit Proof Fence, N of Ravensthorpe-Esperance road, Nov. 1967, *E. Wittwer* (PERTH).

Habitat. In yellow sand in tall shrubland, on plains.

Flowering period. March to May.

The most recently discovered species of the genus in Western Australia, *Banksia lullfitzii* is rare, known from only three widely separated localities. Its habit is very like that of *B. elderana*, its closest relative and a common species in the same region, so that when not in flower the two could be mistaken for each other. Much of the region is still difficult of access, and *B. lullfitzii* may prove more common when thorough surveys have been made.

The species is distinguished from *B. elderana* by its narrower leaves; larger, erect inflorescences; orange flowers; tomentose and woolly perianths; and large follicles. The seedlings are very similar, but the teeth of the leaves in *lullfitzii* are more oblique and narrow more quickly towards their apices than in *elderana*. In colour and indumentum the flowers of *lullfitzii* resemble *B. audax*, with which it is sympatric in the northern part of its range. The species, in the few collections seen, is consistent except for variation in the size of the inflorescence and perianth.

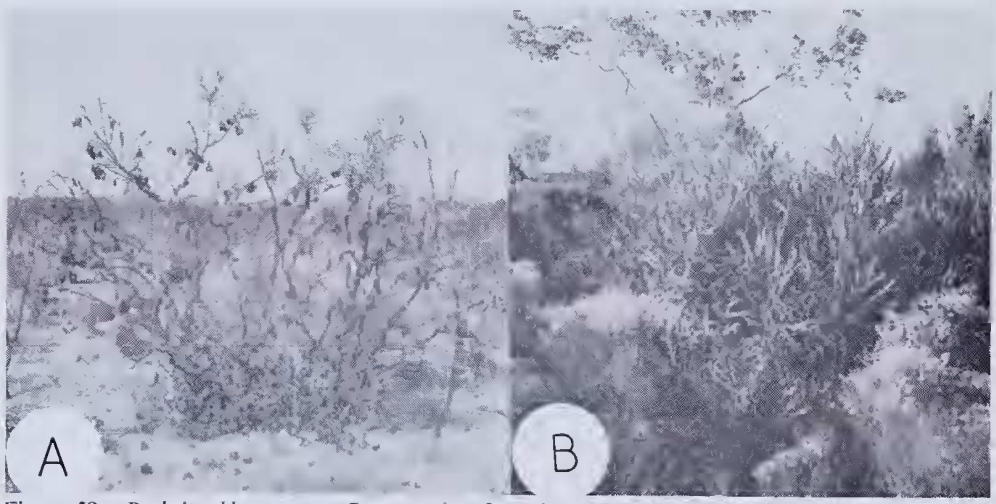


Figure 58. *Banksia elderana*. A—Regeneration from lignotuber after fire, with old pendulous fruit above (E of Southern Cross, W.A.). B—Habit (E of Newdegate, W.A.).

37. Banksia elderana F. Muell. & Tate (Figure 58)

Bot. Centralbl. 57, 10:317 (1893)—as *Elderiana*.

Type citation: "Victoria Desert; R. Helms". Lecto (here chosen): MEL 52576, annotated by Mueller "No. 2, Banksia Elderiana 1891" and labelled "Elder Exploring Expedition No. 2 Banksia Victoria Desert. Camp 54. Lat. 29°33'25" long. 124°38'. R. Helms 17/9/91." Iso: K, MEL 52574 and 52575, NSW, PERTH.

Cotyledons (Fig. 8.32) cuneate, widely spreading, 11–12 mm long, 10–12 mm wide, reticulate, dull green; upper margin somewhat oblique and slightly undulate; auricles spreading or descending, acute, 1·5–2 mm long. *Hypocotyl* short, thick, glabrous, dark red. *Seedling leaves* crowded; first 2 opposite, next 2 also, then scattered; first 2 in outline narrowly obovate-cuneate, 19–25 mm long, 11–13 mm wide, ± obtuse but mucronate, margins slightly recurved, serrate with 1–2 mucronate teeth, the larger 3–5 mm long; upper surface loosely hirsute, lower hirsute and with white wool in lacunae; second 2 leaves narrowly obovate, 4–5 cm long, 15 mm wide, with 5–8 marginal teeth, next leaves becoming longer (10–12 cm) and broader (15–22) mm, with flat margins and numerous pungent teeth, hirsute, the indumentum disappearing except wool in lacunae; leaf bases broad, almost stem-clasping, closely pubescent. *Seedling stem* closely pubescent with curled hairs and loosely hirsute.

Mature plant a shrub to 3 m with lignotuber, much branched and bushy. *Branchlets* somewhat angular becoming terete, at first 4–5 mm thick, densely tomentose, ferruginous, turning grey, becoming glabrous after 2–4 years; prophylls at base linear, thick, up to 10 mm long, densely tomentose. *Leaves* linear, rigid and usually flexuose, acute, 15–40 cm long, 12–20 mm wide; margins flat, serrate almost to base, the teeth with concave margins, pungent, mostly 3–5 mm long; sinuses U-shaped, sometimes broadly V-shaped, mostly 5–17 mm across; lamina tomentose-hirsute above and on midrib below, becoming glabrous; reticulum on lower surface shortly tomentose becoming glabrous, lacunae white-woolly; lamina tapering to a tomentose petiole 1–2 cm long; leaf bases thick. *Inflorescence* pendulous, terminal to leafy branchlet of recent growth or 1–2 years old, the branchlets often lateral to a main stem; broadly cylindrical, 5·5–7·5 cm diam. at anthesis. *Axis* 4–6 cm long, 5–6 mm wide, 13–15 mm wide with common bracts, without flowers for 2–4 mm at base. *Involucral bracts* linear-terete on thick bases, ± obtuse, with thick tomentum, 4–9 mm long, spread over ± 1 cm of branchlets. *Common bracts* linear, 4–6 mm long, densely hirsute; exserted apex conical, straight, tomentose, brown with extreme apex pale. *Floral bracts* shorter and narrower, the apex very small. *Flowers* yellow throughout, including styles. *Perianth* 27–29 mm long, including limb of 4–5 mm, straight; claws 0·5 mm wide above base, tapering, appressed-pubescent to shortly hirsute outside, glabrous inside; limb narrowly oblong, obtusely keeled, faintly nerved each side, the apex obtuse and slightly incurved, glabrous. *Anthers* ± 2 mm long on very short filaments, apiculate. *Hypogynous scales* linear, obtuse, 1–1·5 mm long. *Pistil* 24–28 mm long, straight, pubescent to shortly hirsute at base, the hairs becoming sparse upwards, upper 1/2–1/3 glabrous; pollen-presenter linear-terete, obtuse, 2·5 mm long, slightly swollen at base, smooth; stigmatic groove oblique; ovary densely pubescent at apex, otherwise glabrous. *Infructescence* ± ovoid, 5–7 cm diam.; old perianths and styles persistent. *Follicles* up to 30, in plan view broadly elliptic-ovate, 15–25 mm long, 8–14 mm high, 10–18 mm wide; valves semi-elliptic but somewhat expanded to stylar side, convex, smooth or very slightly rugose, densely hirsute-tomentose, the hairs gradually wearing off, grey, slightly mottled; follicles mostly opening with fire, to 18 mm wide; valves somewhat recurved, split from stylar point leaving a beak; lips 1–2 mm wide, even or wider on anti-stylar side. *Seed* obovate, 23–27 mm long; seed body triangular, 10–12 mm long, 9–12 mm wide, acute at base, upper margin on inner side acutely flanged; inner surface otherwise ± flat, smooth or slightly rugose, black-brown, ± glistening; outer surface convex, rugose near base, irregularly and acutely ridged above, pale grey-brown, the ridges black; wing 15–18 mm wide, curved to stylar side, deeply split from stylar point leaving ± oblong lobe, grey-brown outside, black-brown inside, somewhat wrinkled. *Separator* similar to seed in shape and size, flat against seed body with overhanging ridge across top, thickened and beaked to stylar point, wings slightly recurved.

Distribution. (Fig. 55) Western Australia: central south region, between Narembeen and Lake King, eastwards almost to Peak Charles and north-eastwards to Bullabulling; with outlying populations near Queen Victoria Spring and in the south-western Great Victoria Desert.

Selected collections. 16 km E of Narembeen along road to Mt. Walker, 16 Aug. 1975, *M. D. Crisp* 1093 (CBG, PERTH); 47 km E of Newdegate, 27 Nov. 1978, *A. S. George* 15269 (PERTH); Boorabbin, 4 Feb. 1935, *C. A. Gardner* s.n. (PERTH); 90 mile Tank between Lake King and Peak Charles, 24 May 1955, *A. R. Main* s.n. (PERTH); Hollands Track, 33 miles (53 km) SW of Queen Victoria Rocks, Sept. 1966, *R. Filson* 8899 (MEL); 2 miles (3 km) S of Queen Victoria Spring, 26 Jan. 1956, *R. D. Royce* 5289 (PERTH).

Habitat. In yellow sand, or sandy loam over laterite, in tall open shrubland and in heath. *Flowering period.* January to March, sometimes continuing into winter.

When Mueller and Tate described *B. elderana* they had fragmentary material in which the inflorescence was separated from the branch, and consequently they did not realise that it is pendulous. It is the only species of the series *Cyrtostylis* to have this character. Other diagnostic features are the long, rigidly dentate leaves, the yellow flowers and the perianth with pubescent claws and glabrous limb. The leaves are very similar to those of *B. hullfitzii* C. Gardner but are usually a little wider. The latter also has larger, tomentose, orange-brown flowers. Both *elderana* and *hullfitzii* form very tangled shrubs caused mainly by the long, flexuose but rigid leaves with their pungent lobes.

Banksia elderana is the only species of the genus known to extend into the desert. The type locality is some 130 km north east of Queen Victoria Spring; unfortunately the type has no habitat data. The region is difficult of access, and further exploration is needed to learn more of its occurrence there. In the main area of distribution, between Bullabulling and Lake King, the species is locally common.

38. Banksia elegans Meissner (Figure 56B)

Hook. J. Bot. & Kew Gard. Misc. 7:119 (1855)—*Sirmuellera elegans* (Meissner) Kuntze, Rev. Gen Pl. 2:582 (1891).

Type citation: "Drummond, coll. vi. n. 200". Lecto (here chosen): BM; iso: CGE, K, LD, MEL (3 sheets), P, U. There is no specimen at NY, where Meissner's Proteaceae are housed.

Seedlings not seen.

Mature plant a shrub to 4 m with fire-tolerant rootstock, often suckering. *Trunk* irregular, to 15 cm thick. *Bark* somewhat tessellated, not friable, grey. *Branchlets* terete, 4–8 mm thick, densely tomentose with short curled hairs and loosely hirsute with long spreading ones, the latter soon deciduous, pale brown turning grey, becoming glabrous after 2–3 years; old leaf scars prominent. *Leaves* scattered, broadly linear, acute, 20–45 cm long, 12–18 mm wide, usually somewhat flexuose and undulate; margins flat, dentate about 1/2-way to midrib with triangular acute to obtuse lobes up to 6 mm long, the margins of the lobes convex to gently sigmoid; sinuses V-shaped, mostly 4–12 mm wide; lamina narrowed to petiole of 2–4 cm; lamina densely tomentose above, also hirsute along midrib and at lobe apices, becoming glabrous; tomentose and hirsute below on midrib, the lateral veins tomentose, all becoming glabrous leaving only wool in the fine lacunae; midrib pink-orange; each lobe with 3 converging nerves, reticulate between. *Inflorescence* spherical, rarely ovoid, terminal to recent branchlet, 6–7 cm diam. at anthesis. *Axis* 1·5–5 cm long, 9–10 mm wide, 18–20 mm wide with common bracts, without flowers for 1–5 mm at base. *Involucral bracts* subulate-terete on thick bases, 5–17 mm long, villous-tomentose, ferruginous, usually deciduous before anthesis. *Common bracts* narrowly cuneate, 4–6 mm long, densely hirsute; exserted apex conical, compressed, obtuse, straight or upturned, densely tomentose and often penicillate, cream to pale brown. *Floral bracts* similar but slightly narrower. *Flowers* pale yellow or lemon-yellow throughout, including styles. *Perianth* 32–33 mm long, including limb of 4–5·5 mm, straight; claws with thick basal margins, 1 mm wide above base but quickly narrowed and filiform above, appressed-pubescent outside, the lowermost hairs retrorse, glabrous inside in lower half, pubescent along margins above, midribs prominent; limb narrowly oblong, obtuse, obtusely keeled, 1-nerved each side, the apex incurved, glabrous. *Anthers* 2·5–3 mm long on filaments of 0·5 mm, very shortly apiculate. *Hypogynous scales* oblong, obtusely bilobed, ± 1·5 mm long. *Pistil* 31–32 mm long, ± straight, glabrous except a few appressed hairs above ovary; pollen-presenter linear-terete, narrower than style, 0·7–0·8 mm diam., irregularly ribbed and muricate, dark brown when dry; apex obtuse, somewhat compressed, pale; stigmatic groove terminal, open, ovary glabrous. *Infructescence* small; old perianths and styles early deciduous; most inflorescences setting no fruit; common and floral bracts somewhat enlarged, indurated, grey. *Follicles* 1–5, in plan view ovate, 20–25 mm long, 9–13 mm high, 11–14 mm wide; valves obliquely semi-ovate, curved to stylar side, convex, grey with irregular small white tubercles, shortly

tomentose becoming ± glabrous on exposed parts; follicles opening usually with fire, to 2 cm across; valves split from stylar point leaving a broad obtuse beak; lips 1·5–2 mm wide, even. *Seeds* obliquely ovate, curved, 17–20 mm long; seed body ± triangular with rounded corners, 7–10 mm long, 7–11 mm wide; inner surface ± uneven, somewhat rugose, black; outer surface unevenly convex, ± rugose, sometimes finely pitted; wing 16 18 mm wide, obliquely curved to stylar side, dark brown but upper half translucent. *Separator* similar to seed in outline, impressed against seed body, thickened above especially on stylar side where obtusely beaked; wings rigid, slightly recurved.

Distribution. (Fig. 57) South West Western Australia: near the west coast, between Walkaway and Mt. Peron.

Selected collections. Near Walkaway, 7 Oct. 1977, *A. C. Burns* 27 (PERTH); N of Arrowsmith Lake, 16 Oct. 1969, *A. S. George* 9775 (CANB, PERTH); 0·5 km N of Lake Indoon, 14 Oct, 1976. *E. A. Griffin* 622 (PERTH); Diamond of the Desert Spring near Mt. Peron, Jan. 1940, *C. A. Gardner* s.n. (PERTH); Greenough River, Nov. 1877, *F. Mueller* s.n. (B, MEL, NSW).

Habitat. In deep yellow sand on low consolidated dunes in low woodland and tall shrubland, often associated with *B. prionotes*.

Flowering period. October and November.

Banksia elegans is unique among South Western species of the genus in its suckering habit. The only other species of *Banksia* with this habit are some variants of the eastern *B. marginata* and *B. integrifolia*. It also has other unusual characters, especially the spherical inflorescence and the very few, oblique, tuberculate follicles. The leaves somewhat resemble those of *B. ashbyi* but the perianth and pistil are very like those of *B. lindleyana*. For reasons not yet understood, the pollen-presenter in most flowers is shrivelled at anthesis and this may explain the very poor seed set: in the few follicles produced there are rarely any viable seeds. The form of both the follicle and the seed is somewhat like that of *B. ilicifolia* and *B. cuneata* of the subgenus *Isostylis*. The axis, too, is very short like that in the two latter species.

Banksia elegans is a consistent species except for the collection from near Walkaway (Burns 27) which has larger inflorescences than all other populations. The species is locally common though of restricted distribution.

Series **Prostratae** A. S. George, series nova

Frutices cum vel sine lignotuberis. *Caules* prostrati, raro breves et erecti. *Folia* erecta, in petiolis longis. *Inflorescentiae* terminales. *Involucrum* cum bracteis dense tomentosis-hirsutis, ad fructus persistentibus. *Perianthium* ferrugineum, glandulaceum, cremeum vel rubescens. *Pistillum* gracile; pollinis praebitor parum tumidus, ± 0·5 mm longus. *Folliculi* ± grandes, crassi, rotundati, dense tomentosi-hirsuti, post dehiscentia cum rostro laterali. *Cotyledones* late cuneati angulis superis prominentibus, vel late obovati.

Type species: **Banksia repens** Labill.

Shrubs with or without lignotubers. *Stems* prostrate, rarely short and erect. *Leaves* erect on long petioles. *Inflorescence* terminal. *Involucre* of densely tomentose-hirsute bracts persistent to fruiting. *Perianth* ferruginous, pale brown, cream or reddish. *Pistil* slender; pollen-presenter slightly swollen, ± 0·5 mm long. *Follicles* large, thick, rounded, densely tomentose-hirsute, with lateral beak after opening. *Cotyledons* broadly cuneate with prominent upper angles, or broadly obovate.

Derivation of name from the Latin *prostratus*, prostrate, in reference to the habit of all taxa in the series.

The *Prostratae* includes the following six species, all endemic in South West Western Australia: *B. blechnifolia* F. Muell., *B. chamaephyton* A. S. George, *B. gardneri* A. S. George, *B. goodii* R.Br., *B. petiolaris* F. Muell. and *B. repens* Labill. It is a tightly knit series, the specific distinctions being chiefly in habit, leaf lobing and perianth colour. Other distinctions include indumentum, involucral bracts and perianth size. Two species—*B. blechnifolia* and *B. petiolaris*—are non-lignotuberous and have a vigorous habit, reaching 2 m across. The others have lignotubers and are less vigorous, especially *B. goodii*

and *B. chamaephyton* which tend to be clumped with short stems. Only in *B. goodii* is there a tendency occasionally towards upright growth. All taxa in the series flower in mid to late spring except *B. gardneri* var. *hiemalis* and var. *brevidentata* which are winter-flowering. Development of the inflorescence is acropetal.

Five of the included species occur near the south coast, from the Albany district to Israelite Bay, and extending up to 80 km inland. Most populations are in shrubland communities, but *B. goodii* and sometimes *B. gardneri* occur in open-woodlands. The sixth species, *B. chamaephyton*, is well isolated from the others, in the low shrublands between Perth and Geraldton.

The series appears to have developed from the *Orthostylis*. A similar prostrate habit has evolved in many genera in South Western Australia, including the Proteaceous genera *Adenanthos*, *Dryandra*, *Grevillea*, *Hakea*, *Isopogon*, *Petrophile* and *Synaphea*. Clearly there is an intricate story of pollination to be resolved here, probably involving marsupials and other animals, and more complex than the rodent pollination of ground-flowering *Protea* in South Africa (Rourke & Wiens, 1977).

Within the series I consider a possible line of evolution to have been *goodii—gardneri—chamaephyton—repens—petiolaris—blechnifolia*. The last two are non-lignotuberous and the most vigorous species of the series.

39. Banksia goodii R.Br.

Prot. Nov. 36 (1830)—*Sirmuellera goodii* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid., regio mont. prope King George's Sound, 1829. D. Baxter." Lecto (here chosen): BM: a flowering specimen with the label "New Holland King George's Sound & vicinity Mr William Baxter 1829–30"; annotated by Brown. Iso: BM (flowering specimen ± 2 fruit); G (flowering specimen, ex BM, "Possibly collected by William Baxter 1829–30, at King George's Sound"); K (ex Allan Cunningham's herbarium, annotated by Brown); L (flowering specimen, ex BM); NSW (leafy specimen + inflorescence, ex BM); PERTH (flowering specimen, ex BM).

B. barbigera Meissner in Lehm., Pl. Preiss. 2:265 (July 1848).

Type citation: "Swan River, Drummond coll. III. No. 290." Lecto: K; iso: FI, G, K, MEL, P, PERTH.

Cotyledons (Fig. 8.33) broadly cuneate, ± flat, 10–11 mm long, 15–20 mm wide, faintly reticulate, lateral margins slightly convex, upper margin slightly concave but raised in centre, brownish-green with red-brown margins; auricles ± horizontal, obtuse. *Seedling leaves* clustered above cotyledons, narrowly obovate, concave, 4–5 cm long, 1–2 cm wide, on petioles 1–1·5 cm long; margins flat, dentate, the teeth triangular with concave margins, 1–3 mm long. Later leaves progressively longer, more undulate, with larger teeth sometimes irregular.

Mature plant a shrub with lignotuber; stems prostrate, underground, short, sometimes on surface or erect and up to 20 cm high. *Stems* 7–12 mm thick, densely tomentose-hirsute, the leaves interspersed with subulate, densely hirsute prophylls to 4 cm long. *Leaves* broadly oblong to narrowly obovate, obtuse, 20–45 cm long, 3–8 cm wide, very undulate; margins ± flat, irregularly dentate, the teeth up to 10 mm, rarely 15 mm long, obtuse to mucronate; sinuses U-shaped; laminae penninerved, the lateral nerves at angle of about 80°, reticulate between nerves on lower side; lamina densely hirsute above with long straight and short curled hairs, becoming glabrous, hirsute below on midrib and nerves, white tomentose on lamina becoming glabrous except lacunae; lamina narrowed into petiole and decurrent as 2 narrow ribs; petiole 5–18 cm long, tomentose-hirsute; new leaves dark red. *Inflorescence* cylindrical, peduncle short or long, with many subulate hirsute bracts. *Involucral bracts* prominent, subulate, up to 5 cm long, densely hirsute. *Axis* 8–15 cm long, 5·5–6·5 mm wide, 17–19 mm wide with common braced bearing flowers throughout. *Common bracts* linear, 6 mm long, densely hirsute; exsertts, apex small, conical, tomentose. *Floral bracts* similar but slightly smaller. *Flowers* ferruginous to pale brown throughout. *Perianth* 24–26 mm long including limb of ±

3 mm; claws filiform, 0·2–0·3 mm wide, hirsute outside with crinkled hairs, hirsute inside in upper half; limb very narrowly elliptic, ± obtuse, apex densely hirsute with straight hairs, hirsute below with curled hairs but becoming glabrous often before anthesis. *Hypogynous scales* oblong to narrowly triangular, obtuse, ± 1 mm long, free. *Pistil* 29–31 mm long, gently sigmoid with pollen-presenter upturned, glabrous, somewhat tetragonal towards apex; pollen-presenter ± ovoid, 0·3–0·4 mm long, stigmatic groove terminal; ovary 1 mm long, hirsute around apex. *Infructescence* with bracts, old perianths and styles persistent, the latter downturned. *Follicles* up to 15, at first ± concealed, 25–32 mm long, 10–15 mm high, 10–12 mm wide; valves semi-circular to semi-elliptic, smooth, densely hirsute with curled and straight hairs wearing off exposed parts; suture very fine, sometimes slightly undulate; follicles opening with fire, up to 15 mm wide; valves split on each side from stylar point leaving broad obtuse beak; lips 1·5–2 mm wide, 2 mm wide on side opposite style. *Seed* obovate 25–32 mm long; seed body ± triangular, 9–12 mm long, 14–16 mm wide, base acute, lateral margins convex, thin, upper margin on inside with narrow ridge; outer face irregularly reticulate or ridged, dark grey, inner face smooth, brown; wing 20–25 mm wide, ± expanded on stylar side where deeply notched, brown inside, dark brown outside. *Separator* similar to seed in shape; base flat, smooth, with thickened overhanging transverse ridge above; wings recurved when dry; obtuse beak at stylar point.

Distribution. (Fig. 60) South West Western Australia, between the Porongurup Range and Albany.

Selected collections. N of Millbrook road, 29 May 1964, *A. S. George* 6331 (PERTH); Jackson road, Porongurups, 15 Nov. 1977, *P. Luscombe* s.n. (PERTH); 12 miles N of Albany, 11 May 1962, *K. Newbey* 237 (PERTH).

Habitat. In shallow white to grey sand over laterite, in low open-forest or low woodland of *Eucalyptus marginata* and *Casuarina fraserana.*

Flowering time. November.

Banksia goodii can be recognised by the very undulate, irregularly dentate leaves and the prominent hirsute bracts of the stem and involucre. The habit is usually small, without spreading stems as seen in most of the *Prostratae.* It is the only member of the series with a tendency to grow erect, though the tallest stems recorded are only 20 cm tall. The closest relative is *B. gardneri* A. S. George which is usually larger in habit and has more regularly lobed or dentate leaves, smaller, pubescent or shortly hirsute involucral bracts and, usually, smaller inflorescences.

The species, known from only a few populations between Albany and the Porongorups, is the rarest in the genus. It apparently sets few seeds, but has a lignotuber, from which it regenerates after fire.

40. Banksia gardneri A. S. George, nom. nov.

Based on *Banksia prostrata* R.Br. Prot. Nov. 36 (1830), non Forster et Forster f. (1775)—*Sirmuellera prostrata* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occid.-merid., prope King George's Sound, 1823, D. Baxter". Lecto (here chosen): BM, labelled by Brown "Banksia prostrata R.B. from Mr. William Baxter"; there is another label, possibly in Baxter's hand: "grows on Hills, to the east of Oyster Harbour & and Mount Gardner, lays flat on the ground." Iso: BM, K, PERTH.

Derivation of name. In honour of Charles Austin Gardner (1896–1970), Government Botanist of Western Australia 1929–1960. Mr. Gardner had a long interest in the genus *Banksia* and described six new species.

Cotyledons (Fig. 8.34) broadly cuneate, shortly lobed with one lobe higher than other, 18 mm long, 20–25 mm wide, recurved, reticulate, green throughout or tinged with brown; auricles spreading, acute, 3 mm long. *Hypocotyl* thick, glabrous, red. *Seedling leaves* crowded close above cotyledons, narrowly obovate, obtuse, 3–5 cm long, shortly dentate, hirsute.

Mature plant a shrub with lignotuber. *Stems* prostrate, on surface, 4–10 mm diam., densely tomentose with both short, curled and scattered spreading hairs. *Leaves* erect, 10–40 cm long, sometimes shorter, not glaucous; lamina 23–60 mm wide, dentate to pinnatipartite, often undulate; lobes opposite or alternate, triangular to broadly linear or ± ovate, up to 3 cm long, obtuse or acute; sinuses rounded, obliquely U- or V-shaped; margins flat; both surfaces at first hirsute with short, curled and long, spreading ferruginous hairs, becoming glabrous except the lacunae on lower surface which retain white wool; each lobe 3-nerved, finely reticulate between; lamina decurrent to petiole 3–12 cm long, ± terete with narrow lateral ribs; new growth pink. *Inflorescence* usually closely subtended by leaves, the peduncle bearing a few subulate, tomentose bracts up to 2 cm long. *Involucral bracts* numerous, subulate, 1–3 cm long, tomentose-hirsute, ferruginous to grey, persistent. *Axis* 3·5–10 cm long, 5–10 mm thick, 15–20 mm including common bracts; lowermost 5–10 mm without flowers. *Common bracts* linear, 5–7 mm long, densely hirsute; exserted apex ± conical, somewhat upturned, shortly tomentose. *Floral bracts* similar but slightly shorter and narrower. *Flowers* ferruginous, orange-brown, pale brown or pink, the last becoming brown after flowering. *Perianth* 17–26 mm long including limb of 3–4 mm; claws filiform, densely hirsute outside with curled and spreading hairs, hirsute inside in upper half; limb fusiform to narrowly elliptic, obtuse, densely hirsute at first but often becoming glabrous except at apex. *Anthers* 1 mm long on thick filaments 0·5 mm long, shortly apiculate. *Hypogynous scales* linear to oblong, obtuse, 1–1·5 mm long. *Pistil* 18–30 mm long, gently sigmoid, glabrous except a ring of long straight hairs at apex of ovary; pollen-presenter narrowly ovoid, 0·5 mm long, slightly ribbed; stigmatic groove slightly lateral at apex; ovary hirsute at apex with long straight hairs. *Infructescence* ± ovoid, stout; old perianths and styles persistent. *Follicles* up to 25, moderately exposed, 23–40 mm long, 5–20 mm high, 8–15 mm wide; valves semi-elliptic, sometimes ± oblique, smooth, densely hirsute; ridge obtuse, suture very fine; follicles usually opening only with fire, when open up to 2·5 cm across, splitting on each side of stylar point leaving a beak; lips 1·5 mm wide. *Seed* broadly obovate with wing turned to stylar side, 22–37 mm long; seed body ± cuneate, 9–12 mm long, 11–21 mm wide, upper angles acute, base ± acute, lateral margins straight or slightly curved; upper margin with acute ridge on inner face; outer face convex, with irregular ridges, grey; inner face ± flat, smooth, brown or slightly mottled; wing 16–30 mm wide, deeply notched at stylar point, brown. *Separator* similar to seed in size and shape, with a transverse thickened ridge on each face above seed body.

Banksia gardneri requires a new name since its previous name, *B. prostrata* R.Br. (1810) was a later homonym of *B. prostrata* Forster & Forster f. (1775) (= *Pimelea prostata* (Forster & Forster f.) Willd.). The species is characterised by its surface stems, deeply lobed or dentate leaves, tomentose inflorescence bracts and relatively small ferruginous or pink and brown flowers. It is usually a small plant without a vigorous habit.

The species has three varieties distinguished by leaf dentation or lobing, flower colour and flowering period.

40A. Banksia gardneri A. S. George var. **gardneri**

Leaves deep green above, pinnatipartite; lobes 1–3 cm long. *Flowers* ferruginous, rarely pale brown, opening in September and October.

Distribution. (Fig. 61) South West Western Australia, from the Stirling Range to Albany, extending west to Cranbrook and east towards Bremer Bay.

Selected collections. Mt. Barker, December 1898, *R. Helms* s.n. (PERTH); 25 km E of Cranbrook, 18 September 1964, *P. G. Wilson* 3314 (PERTH); 16 miles (25 km) SE of Borden, 27 Nov. 1960, *A. S. George* 1707 (PERTH); Near Albany, Oct. 1926, *T. N. Stoate* (PERTH); Cheyne Beach, 26 Oct. 1971, *N. G. Marchant* 71/709 (PERTH).

Habitat. In sand or gravel, in tall or low shrubland, sometimes in Jarrah low open-woodland.

Flowering period. September to November.

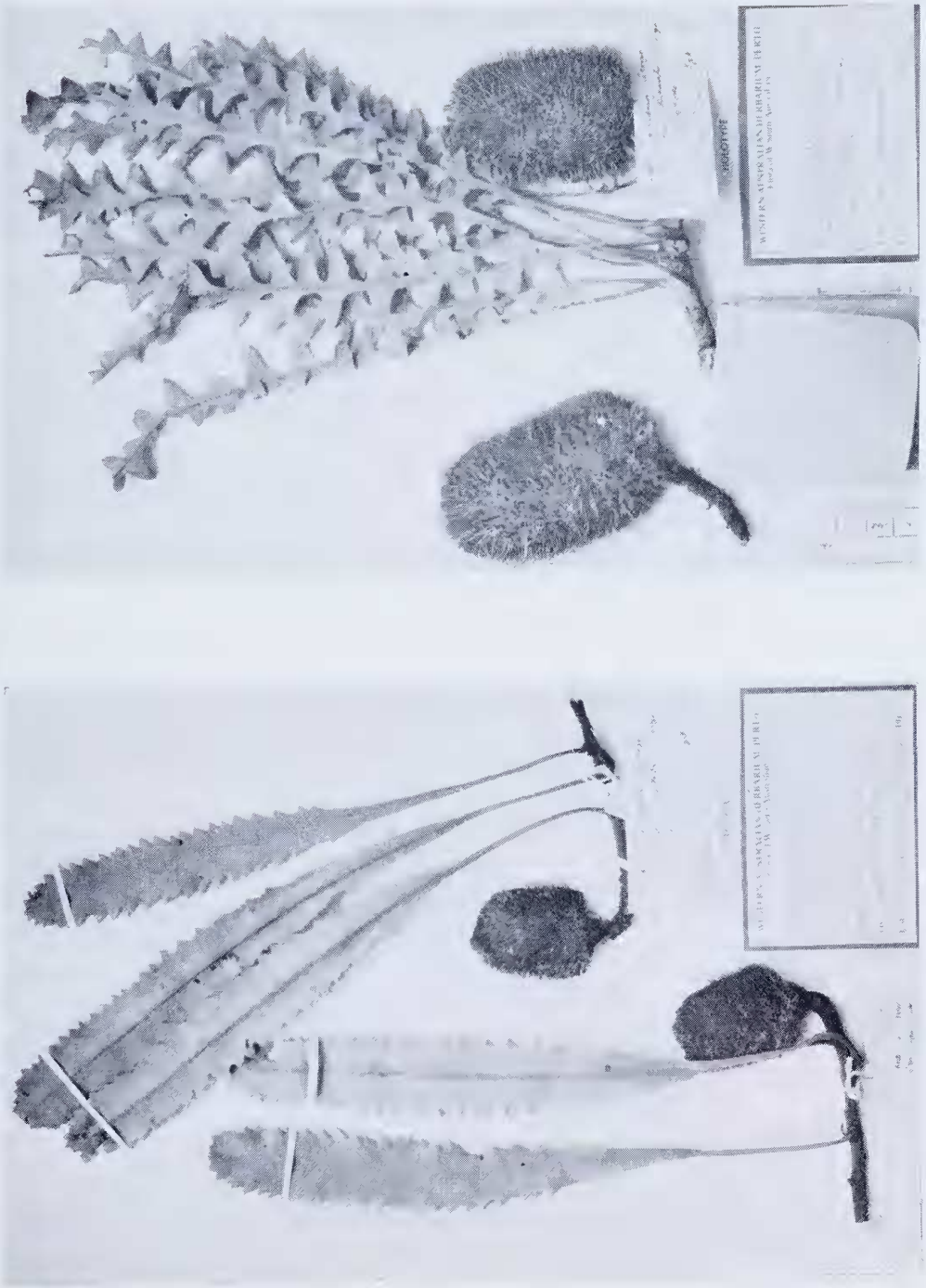


Figure 59. Bottom—*Banksia gardneri* var. *brevidentata*. Holotype, A. S. George 9393 (PERTH). Top—*Banksia gardneri* var. *hiemalis*. Holotype, A. S. George 14354 (PERTH).

40B. Banksia gardneri A. S. George var. **brevidentata** A. S. George, var. nov. (Figure 59A)

Folia supra perviridia, breviter dentata; dentes 2–5 mm longi. *Flores* ferruginei, hieme florentes.

Leaves deep green above, shortly dentate; teeth 2–5 mm long. *Flowers* ferruginous, opening in winter.

Type: Near Bluff Knoll, Stirling Range, Western Australia, 7 July 1969, *A. S. George* 9393. Holo: PERTH; iso: CANB, K, NSW.

Distribution. (Fig. 61) South West Western Australia, in the Stirling Range, with a single collection from near Albany.

Selected collections. Tolls Pass, Stirling Range, 23 April 1923, *C. A. Gardner* 1449 (PERTH); Millbrook Rd., Albany, early Dec. 1963, *F. W. Humphreys* s.n. (PERTH).

Habitat. In white sand, often with schistose rocks, in low woodland of Jarrah or in tall shrubland.

Flowering period. April to July.

Derivation of name. From the Latin *brevis*, short, and *dentatus*, toothed, in reference to the leaf margins.

40C. Banksia gardneri A. S. George var. **hiemalis** A. S. George, var. nov. (Figure 59B)

Folia pallide viridia, pinnatipartita; lobi 0·5–2·5 cm longi. *Perianthium* carneum limbo pallide brunneo; hieme florentes.

Leaves pale green, pinnatipartite; lobes 0·5–2·5 cm long. *Perianth* pink with pale brown limb; style cream; flowering in winter.

Type: 31 km west of Ravensthorpe, 5 Sept. 1976, *A. S. George* 14354 Holo: PERTH; iso: CANB, K.

Distribution. (Fig. 61) South West Western Australia, between Harrismith, West Mt. Barren and Ravensthorpe.

Selected collections. 9 miles (15 km) due E of Harrismith, 1 July 1970, *A. S. George* 9900 (AD, BRI, CANB, K, MEL, NSW, PERTH); between Middle Mt. Barren and Whoogarup Range, 20 Dec. 1970, *A. S. George* 10588(b) (PERTH); 33 km W of Ravensthorpe, 28 May 1975, *A. S. George* 13123 (PERTH); near Ravensthorpe, July 1961, R. Coleman (PERTH).

Habitat. In sand or sandy loam, usually over laterite, in open-heath or low shrubland often with emergent scattered mallee *Eucalyptus*.

Flowering period. June to August.

Derivation of name. From the Latin *hiemalis*, belonging to winter, in reference to the flowering period.

The three varieties are distinguished by leaf form, flower colour and flowering time: var. *gardneri* has deep green pinnatipartite leaves and ferruginous or brown flowers opening in spring; var. *brevidentata* has deep green, dentate leaves and ferruginous flowers opening in late autumn and winter; var. *hiemalis* has pale green pinnatipartite leaves and pink-and-brown flowers opening in winter. The var. *gardneri* and var. *brevidentata* overlap in distribution chiefly in the Stirling Range, but the two never occur together. With the exception of the Humphreys collection from Millbrook Road near Albany, var. *brevidentata* is confined to the Stirling Range. The var. *hiemalis* is disjunct from the other two varieties. Several collections of var. *gardneri* e.g. A. S. George 14382 from South Stirling, have flowers of a paler brown than is typical for the variety, showing a tendency towards var. *hiemalis* in this respect.

The closest relative of *B. gardneri* is *B. goodii* R.Br. which differs in the larger, undulate, irregularly lobed leaves and the large inflorescences subtended by very long densely hirsute bracts. *Banksia goodii* also sometimes has erect stems to 20 cm tall. There is also a relationship with *B. chamaephyton* A. S. George (q.v.), the only prostrate species found in the heaths north of Perth.

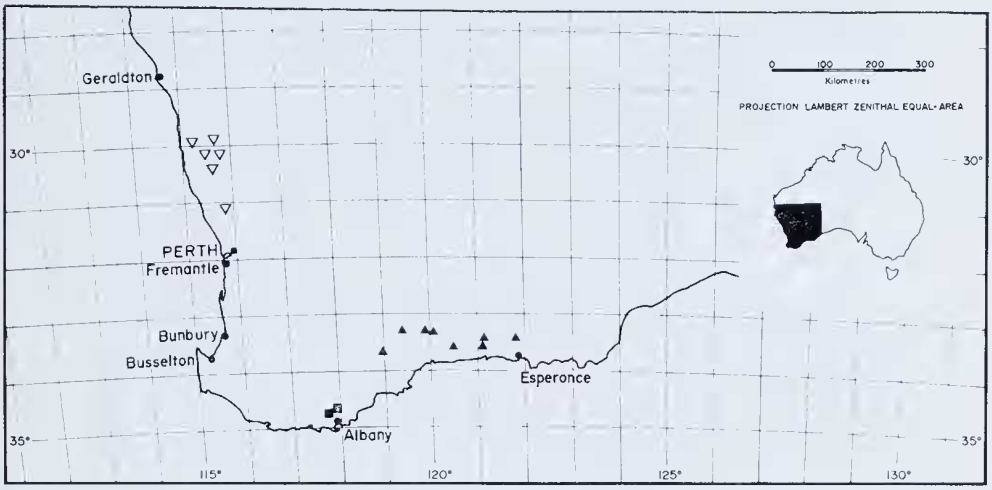


Figure 60. Distribution of *Banksia goodii* (■), *B. chamaephyton* (▽), and *B. blechnifolia* (▲).

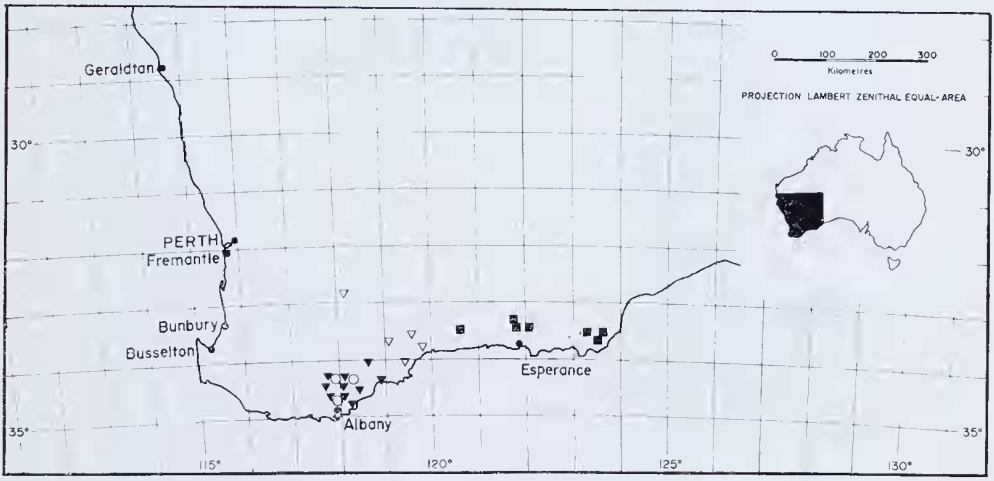


Figure 61. Distribution of *Banksia gardneri* var. *gardneri* (▼), *B. gardneri* var. *brevidentata* (○), *B. gardneri* var. *hiemalis* (▽), and *B. petiolaris* (■).

Figure 62. *Banksia chamaephyton.* Holotype, A. S. George 11204 (PERTH).

41. Banksia chamaephyton A. S. George sp. nov. (Figure 62)

Banksiae gardneri A. S. George affinis, a qua ramis subterraneis, folliis majoribus lobis longioribus, floribus cremeis et brunneis, et folliculis seminibusque majoribus, differt. Folia 20–50 cm longa lobis 2–8 cm longis. Folliculi 25–40 cm longi, 12–20 mm alti, 15–20 mm lati.

Allied to *Banksia gardneri* A. S. George, from which it differs in the underground stems, larger leaves with longer lobes, cream and brown flowers, and larger follicles and seeds. Leaves 20–50 cm long, the lobes 2–8 cm long. Follicles 25–40 mm long, 12–20 mm high, 15–20 mm wide.

Type: W of Mogumber township, Western Australia, in 31°02′ S., 115°58′ E., 15 Nov. 1971, *A. S. George* 11204. Holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Derivation of name. From the Greek *chamae-*, low-growing, and *phyton*, a plant, in reference to the prostrate habit.

Cotyledons (Fig. 8.35) cuneate, 20–21 mm long, 20–24 mm wide, ± convex, dull green; upper margin slightly convex, crenulate; nerves ± reticulate; auricles horizontal, obtuse, 1·5–2 mm long. *Hypocotyl* stout, short, glabrous, pale red. *Seedling leaves* ± crowded immediately above cotyledons; first 2 ± obovate, obtuse, 2–2·5 cm long, divided into 2–3 lobes on each side; lobes obliquely triangular, obtuse, the distal edge 1·5–2 mm long, margins slightly recurved; lamina narrowed to petiole ± 1 cm long; upper side loosely hirsute with white hairs, lower hirsute on veins with pale ferruginous hairs and loosely woolly in interstices with curled white hairs; third and fourth leaves obovate, obtuse, 4–5 cm long, dentate with 6–8 lobes similar to those of first 2 leaves but up to 5 mm long; petiole 1–1·4 cm long; indumentum as in first 2 leaves; new growth pale brown.

Mature plant a shrub to 1 m across with prostrate stems. *Stems* underground, 8–12 mm diam., densely velvety with short curled and long straight ferruginous hairs, the latter wearing off. *Leaves* erect, 20–50 cm long, 4–16 cm wide; petiole 5–21 cm long; laminae pinnatipartite almost to midrib with 10–30 lobes each side, the sinuses U-shaped, 6–17 mm wide; apex obtuse to acute, rigid; lobes opposite to alternate, linear to narrowly triangular, curved gently upwards or straight, acute, set at 70°–85° to midrib, 2–8 cm long, 3–10 mm wide, those towards base of lamina shorter and narrower, those towards apex shorter and broader, flat to slightly concave; indumentum ferruginous; upper surface tomentose with short, curled hairs and loosely hirsute with straight hairs becoming glabrous; lower surface tomentose with short curled hairs and hirsute on nerves with long straight ones, all wearing off except for dense fine white wool in lacunae; each lobe with 3 main and several finer nerves, finely reticulate between on lower surface, the nerves scarcely evident on upper surface; petiole 1·5–3 mm diam., terete but with 2 very narrow ribs on adaxial side formed by decurrent lamina, tomentose-hirsute when young becoming closely tomentose and grey with short curled hairs, the long hairs persistent only at base. *Inflorescence* usually subtended by leaves. *Involucral bracts* linear-subulate from thick bases, 5–15 mm long, ± acute, densely velvety-hirsute with ferruginous hairs, persistent and grey in fruit. *Axis* 6–12 cm long, 5–7 mm wide, 15–18 mm wide with common bracts, bearing flowers throughout or sometimes without flowers for a few mm at base. *Common bracts* linear, thick, 5–6 mm long, densely hirsute; exserted apex obtuse, flat, tomentose. *Floral bracts* similar but slightly smaller. *Flowers* cream with dark brown limb and pale-ferruginous to white indumentum, the apical buds pink, all becoming brown after flowering, then grey. *Perianth* 23–30 mm long including limb of 2·5–3 mm; claws filiform, 0·3–0·4 mm wide, long-hirsute outside, glabrous inside in lower half, sparsely hirsute above, the midrib prominent; limb narrowly elliptic, obtuse, hirsute when young with spreading hairs, a dense tuft at apex, but glabrous by anthesis or soon afterwards, with 3 shallow longitudinal grooves. *Anthers* ± 1·5 mm long on filaments of ± 0·5 mm, shortly and obtusely apiculate. *Hypogynous scales* linear, slightly tapering, obtuse, 1 mm long, free. *Pistil* 25–35 mm long, gently sigmoid with apex slightly upturned, slender, glabrous, narrowed and tetragonal below pollen-presenter; pollen-presenter narrowly ovoid, 0·5–0·75 mm long, obtuse; stigmatic groove lateral

at apex; ovary hirsute with long straight hairs at apex, glabrous below. *Infructescence* moderately large, the old perianths and styles persistent but follicles protruding. *Follicles* up to 15, elliptic in plan view, 25–40 mm long, 12–20 mm high, 15–20 mm wide; valves almost semi-orbicular, slightly off-set to stylar side; valves smooth, densely tomentose and hirsute with short curled and long straight hairs, pale ferruginous becoming grey with age; ridge broadly rounded; suture obscure, straight; follicles usually opening only with fire, when open up to 3 cm across, valves somewhat recurved, split from stylar point to leave prominent lateral beak; lips 1 mm wide, not enlarged laterally. *Seed* ± broadly obovate, 27–36 mm long; seed body ± cuneate with convex margins, 11–17 mm long, 14–22 mm wide, base obtuse to acute, upper margin with an acute ridge on inner side; inner face smooth, mottled brown and cream, outer deeply and irregularly pitted, grey-brown; wing strongly curved to stylar side, 22–35 mm wide, split to seed body from stylar point leaving an ovate secondary lobe. *Separator* similar to seed in outline and size, flat against seed body with a thick, overhanging ridge on each side above.

Distribution. (Fig. 60) South West Western Australia, near the west coast between Mogumber and Eneabba.

Selected collections. W of Winchester on Green Head road, early Dec. 1970, *C. Chapman* s.n. (AD, BRI, CANB, K, MEL, NSW, PERTH); Badgingarra W of (Dept. of Agriculture) Research Station, 19 Jan. 1962, *C. A. Gardner* s.n. (PERTH); 15 miles eastwards from Mount Peron, 26 Aug. 1949 (old fls.) *F. A. Grigson* s.n. (PERTH).

Habitat. In grey-white sand over laterite, in open-heath.

Flowering period. Late October to early December.

Banksia chamaephyton has as its closest relative *B. gardneri* var. *hiemalis.* It differs from that taxon in the underground stems, the larger leaves with longer lobes, the brown and cream perianth, a less dense indumentum on the perianth, the broader perianth limb, and the larger follicles and seeds. It is widely separated geographically from *B. gardneri* in all its three varieties, being the only prostrate *Banksia* in the heaths north of Perth. It is one of the rare species of the genus, known from only eight collections. Several of these localities have now been cleared for agriculture, while the species is not common at the others.

The species is somewhat variable in the size of the leaves and the length of the lobes but is otherwise fairly uniform.

Figure 63. A—*Banksia petiolaris.* Habit. B—*B. repens.* Habit; young inflorescence (left), old inflorescence (centre). (Both SW of Mt. Ragged W.A.).

42. Banksia repens Labill. (Figure 63B)

Voy. 1:411, tab. 23 (Jan.–Feb. 1800).—*Sirmuellera repens* (Labill.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: none given, but Labillardière referred in his journal to finding the species on the mainland at Esperance Bay. Lecto (here chosen): FI, a sheet with one flowering specimen, annotated by Labillardière. Another sheet at FI, also annotated, bears a single leaf from the same specimen.

Banksia polypodiifolia J. Knight, Prot. 113 (Dec. 1809), nom. illeg., superfl. *Type* as for *B. repens* Labill.

Cotyledons (Fig. 8.36) obovate, slightly oblique, 13 mm long, 15 mm wide, convex, ± deep green, shining, faintly reticulate; auricles spreading or descending, acute, 2 mm long. *Hypocotyl* short, thick, glabrous, pale green. *Seedling leaves* crowded above cotyledons; first 2–3 narrowly obovate, obtuse, ± 3 cm long, ± 1 cm wide, with 3–4 triangular lobes each side, margins recurved; lamina hirsute on both sides with pale ferruginous hairs becoming glabrous except for loose white wool in lacunae; next 2–3 leaves narrowly obovate, 5–6 cm long, 1·5–2 cm wide, obtuse, dentate with triangular obtuse lobes 2–4 mm long; margins almost flat; petiole ± 1 cm long; indumentum as in first leaves; later leaves obovate, mucronate, 8–15 cm long, 2·5–5 cm wide, dentate to pinnatipartite, the lobes entire or with a second lobe, acute, to 2 cm long.

Mature plant a shrub with lignotuber; stems horizontal, 1–4 cm below ground level, thick, densely ferruginous-tomentose; linear prophylls along stem at beginning of an annual shoot and below inflorescence. *Leaves* erect, scattered, 25–40 cm long, pinnatipartite with 5–10 opposite or alternate lobes on each side and several smaller lobes towards base and apex; main lobes broadly linear-oblong, narrowly cuneate or narrowly triangular, up to 9 cm long, 7–22 mm wide, the apex truncate or triangular, obtusely mucronate, the lobes straight or slightly up-curved, midrib (of lobe) near lower margin and usually a secondary nerve above, otherwise reticulate, the lobes usually themselves unequally lobed with 1–6 ± triangular obtuse lobes up to 4 mm long on each side; venation obscure on upper surface; lobes towards base and apex of leaf smaller, ± triangular, obtuse, entire; petiole 7–12 cm long, terete at base, upper part with 2 lateral ribs formed by decurrent lamina; new growth ferruginous. *Inflorescence* often up to 20 cm from leaves and appearing isolated on soil, 6–7 cm wide at anthesis. *Axis* 6–10 cm long, the lower 5–10 mm without flowers. *Involucral bracts* linear from a broad base, 3–10 mm long, densely and shortly tomentose. *Common bracts* linear, 5–6 mm long, densely hirsute with ferruginous hairs becoming shorter towards apex; exserted apex ± truncate or shortly conical, densely pubescent with short, curled black hairs, longer and paler at the very tip. *Floral bracts* similar but shorter and narrower, the apex small. *Flowers* cream and pink, sometimes pale brown; style pale pink or cream. *Perianth* 26–29 mm long including limb of 2·5–3 mm, ± straight; claws ± 0·2 mm wide, hirsute outside with spreading, crisped hairs becoming shorter towards limb, glabrous inside; limb narrowly elliptic, slightly constricted above base, obtuse, hirsute outside with pale, ± wavy hairs, the hairs longer and more dense towards apex, often wearing off centre of limb. *Anthers* ± 1 mm long, the filaments slightly shorter. *Hypogynous scales* oblong to narrowly triangular, free, obtuse, 0·5–1·5 mm long. *Pistil* 28–33 mm long, up-curved in upper third, tetragonal just below pollen-presenter, glabrous; pollen-presenter ± 0·5 mm long, oblong but only slightly swollen, stigmatic groove terminal; ovary 1·5 mm long, long-hirsute in upper half. *Infructescence* with old perianths and styles long-persistent turning grey. *Follicles* few, slightly exceeding flowers, 20–40 mm long, 10–30 mm high, 12–15 mm wide, obtusely rounded; valves semi-circular to semi-elliptic, densely tomentose-hirsute with spreading hairs that may wear off with age; suture fine; follicles opening only with fire, to 20 mm across; valves ± recurved; lips 1·5–2 mm wide, fairly even. *Seed* obovate, 3–4 cm long; seed body 14–17 mm long and wide, ± cuneate, base acute, margins thin with a wing 1–2 mm wide; outer surface convex, pitted, the pits aligned ± vertically, grey; inner surface ± smooth, cream; the upper margin thickened into an acutely-edged ridge on the inner side; wing rounded, 24–30 mm wide, somewhat curved towards stylar side with notch about centre, brown inside, pale grey-brown outside but

darker towards apex. *Separator* similar to seed in shape and size, thin where adjacent to seed body with a transverse reflexed ridge across the upper side and then thickened above especially on the stylar side, the wings thinner.

Distribution. (Fig. 64) South West Western Australia, from the Stirling Range to Israelite Bay.

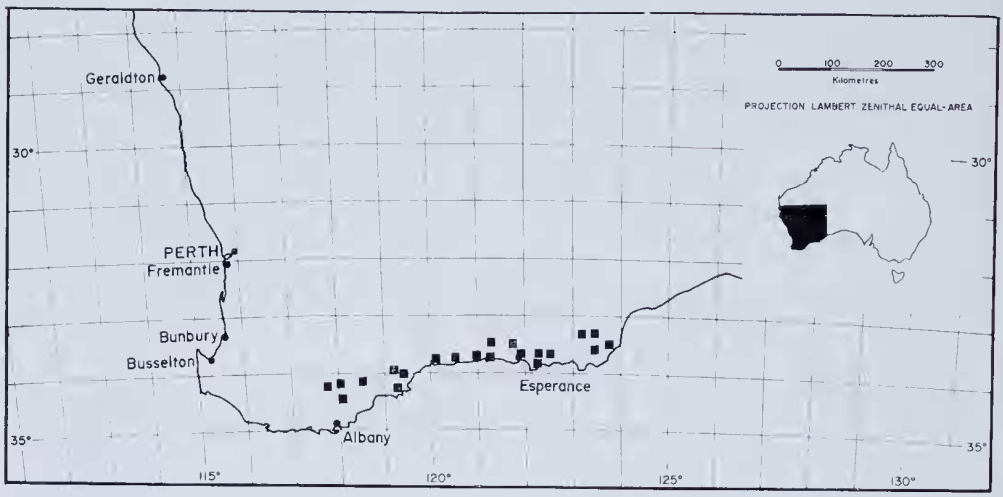


Figure 64. Distribution of *Banksia repens*.

Selected collections. East of Cranbrook, northern edge of Stirling Range, 16 Oct. 1962, *T. E. H. Aplin* 2033 (PERTH); 25·5 miles (40 km) SE of Borden on Bremer Bay road, 27 November 1960, *A. S. George* 1718 (PERTH); ca. 14 km E of the mouth of the Oldfield River, 12 Oct. 1968, *Hj. Eichler* 20218 (AD, PERTH); Lucky Bay, 8 Oct. 1966, *P. G. Wilson* 5602 (NBG, PERTH); Israelite Bay, 21 Oct. 1960, *C. A. Gardner* 12911 (PERTH); 30 km W of Mt. Ragged, 10 Sept. 1964, *P. G. Wilson* 2956 (AD, PERTH).

Habitat. In deep white or grey sand or sandy loam, sometimes with gravel, in open heath and tall shrubland; sometimes on consolidated coastal dunes.

Flowering period. October to November.

Banksia repens is the most widespread species of the *Prostratae* and is easily recognised by its irregularly pinnatipartite leaves, underground stems, and cream and pink flowers. Its closest relative is probably *B. petiolaris* which lacks a lignotuber and has stems on the surface with shortly dentate leaves that remain white-tomentose below. In *B. repens* the leaves tend to be crowded in clusters, and the inflorescences at flowering are not subtended by leaves. Only a few follicles are produced, many inflorescences setting none. The new leaves, produced in spring and early summer, are deeply ferruginous.

Apart from variation in size of leaves, leaf lobes and follicles, the species is relatively uniform.

43. Banksia blechnifolia F. Muell.

Fragm. 4:108 (May 1864).

Type citation: none given in the protologue, but in Additamenta ad Volumen Quartum, p. 177 (Nov. 1864), Mueller cited "In Nova Hollandia austro-occidentali". I have selected as lectotype a sheet (MEL 47981) labelled in Mueller's hand "S. W. Austr. Fol. immerso-nervosa. Maxwell 1861". It contains one specimen which agrees with Mueller's protologue; the sheet was seen by Bentham.

B. pinnatisecta F. Muell., Fragm. 7:58 (Oct. 1869). Nomen nudum, mentioned as an apparent variety of *B. repens*. This name appears in Mueller's hand on the lectotype sheet of *B. blechnifolia*.

Cotyledons (Fig. 8.37) broadly cuneate with upper margin convex, slightly oblique, 10–11 mm long, 14–15 mm wide, faintly reticulate, deep green; auricles spreading, acute, 2 mm long. *Hypocotyl* very short, stout, *Seedling leaves* not recorded.

Mature plant a shrub without lignotuber. *Stems* prostrate, on surface or lightly covered with sand, up to 70 cm long, 7–10 mm diam., openly branched, densely woolly with pale ferruginous curled hairs, becoming grey with age. *Leaves* erect, 25–45 cm long, including petiole 5–18 cm long; lamina pinnatipartite with 8–22 lobes on each side, apex acute, pungent; lobes opposite or alternate, broadly linear to narrowly triangular, ± flat, entire, tapering in upper third to acute apex, narrowly decurrent from lower side at base, set at 60°–80° to midrib, straight or gently curved, 2–5 cm long but shorter towards apex and base of lamina; sinuses U- or broadly V-shaped, 5–25 mm wide; both surfaces and petiole densely tomentose and somewhat hirsute with curled and ± straight ferruginous hairs, becoming glabrous and blue-green except for fine white wool in lacunae of lower surface; each lobe with 3 main and several finer nerves but scarcely evident on upper surface, the lower also finely reticulate; petiole ± 2 mm thick, terete but with 2 very narrow ribs on adaxial side formed by decurrent lamina; new growth ferruginous. *Inflorescence* terminal, the stem below usually leafy but sometimes the last few cm bearing linear villous bracts. *Involucral bracts* numerous, linear-terete, tapering, acute, 1–3 cm long, densely villous with ± straight ferruginous hairs, persistent to fruiting. *Axis* 6–16 cm long, 8–11 mm wide, 22–28 mm wide with common bracts. *Common bracts* linear, slightly widened towards apex, 7–10 mm long, densely hirsute with straight ferruginous hairs, the hairs slightly shorter on exserted apex. *Floral bracts* similar but slightly shorter. *Flowers* reddish-pink becoming cream towards base, after flowering turning pale brown then grey. *Perianth* 28–32 mm long including limb of 3·5–5 mm, ± straight but with limb upturned before anthesis, afterwards relaxed; claws filiform, 0·3–0·4 mm wide, pubescent on both sides with curled hairs, densely so outside, more sparsely inside; limb very narrowly obovate, obtuse, densely hirsute with ± curled white hairs at apex, more sparsely below. *Anthers* ± 1·5 mm long on filaments of ± 1 mm, shortly and obtusely apiculate. *Hypogynous scales* narrowly linear but tapering, acute, 1·5 mm long, quite free from each other. *Pistil* 30–38 mm long, the upper half curved upwards, tetragonal and narrowed below pollen-presenter, glabrous; pollen-presenter straight, 0·5–1 mm long, slightly swollen at base, oblong above; stigmatic groove lateral at apex; ovary with apical ring of straight hairs, otherwise glabrous. *Infructescence* moderately large, the old perianths and styles persistent, ± obscuring follicles. *Follicles* up to 25, elliptic in plan view, 20–30 mm long, 5–10 mm high, 10–15 mm wide; valves semi-elliptic, smooth but densely villous, exposed parts at length glabrous; ridge rounded; suture straight or slightly undulate; follicles usually opening only with fire, when open up to 25 mm across, with a split on each valve from stylar point leaving a lateral beak; lips 1 mm wide, widening to 2–2·5 mm on side opposite style. *Seed* cuneate-obovate, 20–25 mm long; seed body cuneate with curved margins, 9–12 mm long, 12–17 mm wide, base obtuse, upper margin curved with acute ridge on inside, inner face smooth, dark brown; outer face convex, pale grey-brown with irregular almost black pits; wing curved-obovate, 15–26 mm wide, with deep split from stylar point leaving oblong secondary lobe. *Separator* similar to seed in outline and size, with broad beak to stylar point and swellings at base of wings corresponding to ridge on upper margin of seed body.

Distribution. (Fig. 60) South West Western Australia, between Jerramungup and Gibson; not recorded within 10 km of the coast, nor extending north quite as far as Newdegate or Lake King.

Selected collections. Plains near Middle Mt. Barren, Nov. 1931, *C. A. Gardner* and *W. E. Blackall* (PERTH); NE of Jerramungup, 30 Oct. 1965, *A. S. George* 7025 (PERTH); N of Esperance, 12 Sept. 1964, *R. H. Kuchel* 1725 (AD, PERTH); SE of Lake King, 31 Oct. 1965, *K. Newbey* 1838 (PERTH).

Habitat. In white sand, among low heath usually with emergent mallees such as *Eucalyptus tetragona.*

Flowering period. Late September to mid November.

Although published in 1864 the name *Banksia blechnifolia* has only recently been brought into use. Bentham (1870) placed it in synonymy under *B. repens* Labill., and

perhaps because there is no collection annotated as *blechnifolia* by Mueller the name has subsequently been overlooked. Mueller (1869) referred to it as *pinnatisecta* (the name with which he annotated the type) when he suggested that it and *B. petiolaris* were varieties of *B. repens*.

Following Maxwell's collection the species was not collected again until 1931 when Blackall and Gardner found it near Middle Mt. Barren. It has been collected more frequently in the past 20 years following the opening up of the region for agriculture.

The species is readily recognised by its blue-green foliage and reddish flowers, being the only prostrate *Banksia* with these colours. It is uniform throughout its range. The closest relative is probably *B. petiolaris* which sometimes develops a pink tinge to its otherwise cream flowers, but which has shortly dentate leaves that are white-tomentose below. Both species are vigorous, non-lignotuberous plants.

44. Banksia petiolaris F. Muell. (Figure 63A)

Fragm. 4:109 (May 1864)—*Sirmuellera petiolaris* (F. Muell.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In planitiebus arenosis inter Cape le Grand et Cape Arid, Maxwell". Holo: MEL, det. Mueller and labelled "Sand plains Interior Cape le Grand and seen occasionally on to Cape Arid". Iso: PERTH, consisting of leaf fragments and loose flowers.

Cotyledons (Fig. 8.38) broadly cuneate, 12–14 mm long, 18–20 mm wide, ± flat, faintly reticulate, widely spreading, dull green throughout; auricles horizontal to descending, ± 2 mm long, acute. *Seedling leaves* clustered above cotyledons, elliptic to narrowly obovate, obtuse; first two 3·5 cm long on petioles 1 cm long, dentate with 2–3 lobes each side, the teeth 2–4 mm long with distal side the shorter, sinuses U- to V-shaped, margins slightly recurved; lamina loosely hirsute above becoming glabrous, hirsute below on midrib, otherwise woolly-tomentose; next leaves ± 5 cm long with petioles ± 1 cm long, margins dentate with 7–10 triangular teeth up to 3 mm long, the sinuses V-shaped.

Mature plant a shrub without lignotuber up to 2 m across. *Stems* prostrate on surface or lightly covered, 6–12 mm thick, densely tomentose, ferruginous; scattered linear tomentose prophylls at base of annual shoots. *Leaves* erect, 20–40 cm long, 1·8–4 cm wide, broadly oblong, to narrowly obovate, truncate with an obtuse mucro, margins slightly recurved, shortly dentate with numerous teeth except towards petiole, the teeth broadly triangular, obtuse, 2–4 mm long, sinuses U-shaped; lamina velutinous above with ferruginous hairs becoming glabrous, densely tomentose below with white, curled persistent hairs, the midrib and nerves tomentose with ferruginous hairs becoming glabrous; lamina tapering to petiole 6–15 cm long, tomentose; new growth deep red. *Inflorescence* usually subtended by leaves and linear bracts, 6–7 cm diam. *Axis* 9–16 cm long, 5–6 mm wide, 15–16 mm wide with common bracts, bearing flowers except for up to 1 cm at base. *Involucral bracts* subulate from thick bases, acute 10–25 mm long, densely tomentose. *Common bracts* linear, 5 mm long, densely hirsute; exserted apex very short, conical, obtuse, shortly hirsute. *Floral bracts* similar but shorter and not exserted. *Flowers* pink or reddish with cream limb, becoming brown then at length grey; style cream. *Perianth* 24–27 mm long including limb of 3·5–4 mm; gently curved upwards, limb upturned before anthesis, the claws relaxed after anthesis; claws filiform, ± 0·5 mm wide, loosely hirsute outside with ± short wavy white or pink hairs becoming shorter towards limb; glabrous inside or with a few hairs in upper third; limb oblong to narrowly elliptic, obtuse, hirsute with wavy white hairs. *Anthers* ± 1·5 mm long, broadly apiculate, on filaments nearly 1 mm long. *Hypogynous scales* very narrowly triangular, obtuse, 1·5–2 mm long. *Pistil* 31–34 mm long, gently sigmoid with apex slightly upturned, glabrous, narrowed into pollen-presenter which is scarcely enlarged, 0·5 mm long; stigmatic groove terminal; ovary with ring of long straight hairs about apex. *Infructescence* oblong; involucral bracts, old perianths and styles persistent. *Follicles* somewhat hidden, up to 20, 28–38 mm long, 15–20 mm high, 15–20 mm wide, rounded; valves semi-elliptic but slightly oblique, smooth, densely hirsute-tomentose; suture very fine; follicles opening with fire, up to 2 cm across, the valves somewhat recurved; lips 1 mm wide, scarcely widened laterally. *Seed* ± obovate, 25–28 mm long; seed body 10–15 mm long, 14–20 mm wide,

± triangular, obtuse at base, lateral margins convex, thin; upper margin with narrow ridge inside; outer face deeply and irregularly pitted, inner face smooth, brown with mottled margins; wing obliquely semi-elliptic, 20–24 mm wide, deeply notched on stylar side, dark grey-brown outside, black-brown inside. *Separator* similar to seed in shape and size; basal part flat, smooth; a thick transverse overhanging ridge above.

Distribution. (Fig. 61) South West Western Australia, between Munglinup and Israelite Bay; not recorded more than 50 km inland.

Selected collections. Munglinup, E of Ravensthorpe, Oct. 1968, *G. H. Burvill* s.n. (PERTH); Scadden, 6 Nov. 1978, *R. J. Cranfield* 1054 (PERTH); near Israelite Bay, 21 Oct. 1960, *C. A. Gardner* 12923 (PERTH); 29 miles SW of Mt. Ragged, 6 Dec. 1960, *A. S. George* 2030 (PERTH); N boundary of Cape Arid National Park, 19 Sept. 1976, *R. Hnatiuk* 761220 (PERTH).

Habitat. Banksia petiolaris grows in deep white sand with heath, often with emergent mallee *Eucalyptus* or *Banksia speciosa.*

Flowering time. Mid-October to mid-December.

Banksia petiolaris is readily recognised among the *Prostratae* by its shortly dentate mature leaves that are white-tomentose below, and by its pink and pale yellow flowers. Its closest relative is *B. repens* Labill. in which the stems are consistently underground, the leaves are pinnatipartite with irregular lobes and the flowers are cream. It is also close to *B. blechnifolia* F. Muell., sharing with it a vigorous, non-lignotuberous habit, but differing in the dentate leaves and the flower colour.

Like most other species of the *Prostratae*, *B. petiolaris* is uniform apart from some variation mainly in leaf size.

Series **Tetragonae** A. S. George, series nova.

Frutices sine lignotuberis. *Caules* erecti. *Folia* cuneata-obovata, serrata, marginibus leviter recurvis. *Inflorescentia* pendens in ramulo brevi laterali. *Perianthium* rectum, glabrum, sub anthesin non languescens; limbus prominenter carinatus, ut alabastro tetragonus videtur. *Pistillum* rectum, glabrum; pollinis praebitor angustus, 4–8 mm longus, subtiliter costatus, minute muricatus. *Folliculi* maximi, rotundati, post dehiscentia cum rostro laterali. *Cotyledones* late cuneati.

Type species: **Banksia lemanniana** Meissner

Derivation of name. From the Latin *tetragonus*, four-angled, in reference to the perianth limb in late bud.

Shrubs without lignotubers. *Stems* erect. *Leaves* cuneate-obovate, serrate, the margins slightly recurved. *Inflorescence* pendent, on short lateral branchlet. *Perianth* straight, glabrous, not relaxed at anthesis; limb prominently keeled, giving a tetragonal aspect in the bud. *Pistil* straight, glabrous; pollen-presenter narrow, 4–8 mm long, finely ribbed, minutely muricate. *Follicles* very large, rounded, laterally beaked after opening. *Cotyledons* broadly cuneate.

The *Tetragonae* contains three closely related species endemic in South West Western Australia—*B. aculeata* A. S. George, *B. caleyi* R.Br. and *B. lemanniana* Meissner. The outstanding characters of the series are the pendulous inflorescence, the glabrous perianth with a tetragonal limb and the long, narrow, costate and finely muricate pollen-presenter. The pistil remains slightly shorter than the perianth, not being laterally exserted between the claws before anthesis as occurs in most other species. At anthesis the limb separates but loosely surrounds the pollen-presenter; only later does the perianth curl back on itself leaving the upper part of the style exserted. All three species produce copious nectar, with a honey or mouse-like odour. The inflorescences are somewhat concealed by the foliage.

The series is probably derived from the *Cyrtostylis*, showing affinity with *B. elderana* and *B. lindleyana* of that series.

Figure 65. *Banksia lemanniana*. A—Bark. B—Habit, 3 m tall. (Both E of Ravensthorpe, W.A.).

45. Banksia lemanniana Meissner (Figure 65)

In DC., Prodr. 14:462 (Oct. 1856)—cited in name only in Hook. Kew. Journ. 4:210 (1852)—*Sirmuellera lemanniana* (Meissner) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In colonia Swan River (Drumm. coll. 4, n. 302!)". Lecto (here chosen): BM; iso: B, BM, CGE, FI, G, K, (2 sheets), MEL, NSW, NY, P.

Cotyledons (Fig. 8.39) broadly cuneate with distal margin oblique, widely spreading, 12–15 mm long, 15–18 mm wide, 3-nerved and reticulate, dull green, sometimes reddish outside, the distal margin sometimes finely crenulate; auricles spreading to descending, acute, 2 mm long. *Hypocotyl* 1–2 cm long, 2·5–3 mm diam., pubescent to almost glabrous, red. *Seedling leaves;* first 2 opposite, immediately above cotyledons, ± cuneate, acute, 30–35 mm long, 15–20 mm wide, serrate with 2–4 lobes each side, the lobes acute, 2–6 mm long; sinuses ± V-shaped; margins flat to slightly recurved; lamina loosely hirsute above, hirsute on main nerves below with the lacunae woolly; lamina narrowed to base; higher leaves scattered, obovate-cuneate, acute, 6–8 mm long, 25–35 mm wide; dentate to base, the lobes and indumentum as in first leaves. *Seedling stem* densely tomentose and hirsute.

Mature plant a shrub to 5 m without lignotuber, at first erect, when old often spreading, openly branched. *Trunk* to 15 cm diam. *Bark* thin, finely fissured, not friable, grey. *Branchlets* terete, tomentose with short curled hairs and loosely hirsute with long spreading hairs, greenish-brown, later closely tomentose and grey, becoming glabrous after ± 2 years; prophylls on lower 2–4 cm of branchlet narrowly linear, 5–10 mm long, ± appressed, densely tomentose-hirsute. *Leaves* cuneate-obovate, truncate to obtuse, often pungently mucronate, 3–9 cm long, 12–35 mm wide; margins flat, serrate almost to base, the teeth 1–3 mm long, acute to obtuse, rigid; sinuses obliquely U- or V-shaped, 3–8 mm wide; upper surface of lamina densely tomentose with curled hairs and hirsute with spreading hairs, becoming glabrous; lower surface similar but the long hairs more crowded on midrib and main lateral nerves, becoming glabrous except for white wool in the small lacunae; petiole 5–10 mm long, tomentose; new leaves bright ferruginous. *Inflorescences* terminal to short lateral leafy branchlets from stems mostly 3–5 years old, pendulous, broadly cylindrical, 8–10 cm diam. at anthesis. *Axis* 5–11 cm long, 10–13 mm wide, 22–27 mm wide with common bracts, without flowers for only a few mm at base. *Involucral bracts* narrowly linear on moderately thick bases, 5–10 mm long, tomentose, often hirsute in upper half, brown. *Common bracts* linear, 6–7 mm long, densely hirsute; exserted apex flat or slightly convex, densely tomentose, dark reddish-brown with paler centre. *Floral bracts* similar but slightly shorter, narrower, with small apices.

Flowers pale yellow to lemon-yellow, honey-scented; styles pale yellow; pollen-presenter green. *Perianth* 36–41 mm long including limb of 7–9 mm, straight, not bent below limb before anthesis; claws filiform, 0·6 mm wide, quite glabrous on both sides; limb ± oblong or very narrowly obovate, prominently keeled, apex slightly incurved, glabrous. *Anthers* ± 4 mm long on filaments of 0·5 mm, shortly apiculate. *Hypogynous scales* oblong but slightly tapering, 2·5 mm long, obtuse. *Pistil* 36–41 mm long, quite straight, glabrous except a few appressed hairs at base; pollen-presenter 4–5 mm long, fusiform-terete, slightly constricted at base, somewhat narrowed and compressed at apex, obtuse, minutely muricate; stigmatic groove terminal, very fine, somewhat oblique; ovary shortly hirsute about apex, otherwise glabrous. *Infructescence* massive; old perianths and styles persistent. *Follicles* up to 20, prominent, in plan view rounded-oblong, 30–45 mm long, 20–30 mm high, 20–30 mm wide; valves semi-circular, ± flat-faced in lower half but very thick and prominently rounded towards suture, smoothly rugose, densely hirsute-tomentose, the hairs gradually wearing off exposed area; ridge ± flattened; suture fine; follicles opening usually with fire, to 20 mm, hardly recurved; valves split from stylar point leaving a short, broad beak; lips ± 2 mm wide, even. *Seed* broadly obovate, 40–47 mm long; seed body cuneate with upper margin oblique or convex, obtuse to acute at base, 12–15 mm long, 10–13 mm wide, lateral margins straight or slightly convex, not bordered; upper margin thickened on inside and slightly rugose; inner face ± flat, smooth, black, slightly glistening; outer face convex, slightly and irregularly ridged, dark brown, slightly glistening; wing 30–35 mm wide, curved to stylar side where deeply split leaving a prominent secondary lobe, dark brown outside, shining, black and somewhat glistening inside. *Separator* similar to seed in shape and size, robust, flat and smooth against seed body, a thickened overhanging ridge above, broadly beaked to stylar point; wings somewhat recurved.

Distribution. (Fig. 67) South West Western Australia: near the south coast from West Mt. Barren to Hopetoun, inland to the Ravensthorpe Range and east to the Rabbit Proof Fence.

Selected collections. 1 mile (1·6 km) N of Point Ann, 14 Oct. 1967, *K. Newbey* 2651 (PERTH); Summit of Middle Mt. Barren, Sept 1925, *C. A. Gardner & W. E. Blackall* s.n. (PERTH); Just below summit of Mt. Desmond, 9 Jan. 1979, *B. Barnsley* 466 (CBG, PERTH); 31 km E of Ravensthorpe, 28 Nov. 1978, *A. S. George* 15270 (CANB, K, NSW, PERTH).

Habitat. In rocky soil (quartzite and laterite) on plains and hillsides, in tall shrubland, sometimes in low open-woodland.

Flowering period. October to early January.

Banksia lemanniana has the following diagnostic characters: erect, rather openly branched habit; cuneate-obovate leaves with teeth 1–3 mm long; pendulous inflorescences with pale yellow, glabrous flowers; perianth 36–41 mm long with limb 7–9 mm long; straight pistil with pollen-presenter 4–5 mm long; massive, grey, smoothly rugose follicles, and seeds 40–47 mm long. It is a larger, more open shrub than either of its close relatives, *B. caleyi* and *B. aculeata*.

46. Banksia caleyi R.Br. (Figure 66)

Prot. Nov. 35 (1830)—*Sirmuellera caleyi* (R. Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "Ora occident-merid., mont. prope King George's Sound, 1829. *D. Baxter.*" Lecto (here chosen): BM, a sheet labelled "Nova Hollandia ora occid.-merid. Mont. prope King George's Sound. Mr. Brown from Mr. Baxter." Iso: BM (including fruit), K, L, NSW.

B. caleyi R.Br. var. *sinuosa* Meissner in DC., Prodr. 14:462 (Oct .1856)—cited in name only in Hook. Kew Journ. (1852) 210. *Type citation:* "In colonia Swan River (Drumm. coll. 4, n. 301!)." Lecto (here chosen): NY; iso: BM, CGE, FI, G, K (2 sheetes), P.

Cotyledons (Fig. 8.40) cuneate, spreading, 11–13 mm long, 13–14 mm wide, 3-nerved and reticulate, dull green sometimes with fine red margin; upper margin slightly crenulate; auricles vertical, acute, 2 mm long. *Hypocotyl* 1·5–2 cm long, 2 mm thick, glabrous, red. *Seedling leaves* first 2 opposite, immediately above cotyledons, narrowly obovate,

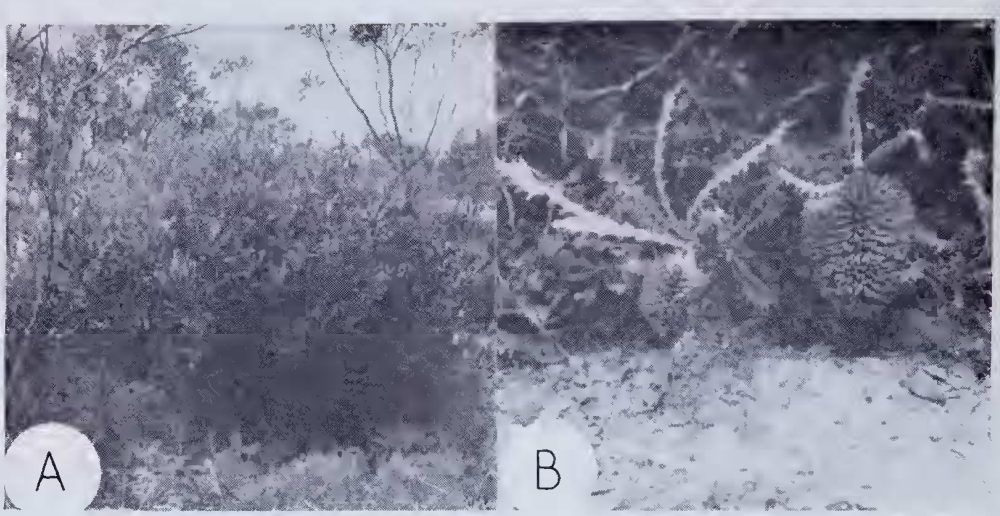


Figure 66. *Banksia caleyi*. A—Habit, 1·5 m tall. B—Pendulous inflorescences. (Both W of Ravensthorpe, W.A.).

obtuse, shortly mucronate, 28–33 mm long, 10–13 mm wide; margins slightly recurved, each with 2–4 obliquely triangular obtuse but mucronate lobes 2–4 mm long; upper surface and midrib below loosely hirsute; lamina loosely woolly below; higher leaves scattered but crowded, up to 8 cm long, 18 mm wide, serrate almost to base, otherwise similar to first leaves; all tapering, sessile or very shortly petiolate. *Seedling stem* hirsute and tomentose.

Mature plant a shrub to 2 m without lignotuber, much-branched and bushy. *Bark* finely fissured, not friable, grey. *Branchlets* somewhat angular-striate, tomentose with short curled hairs, pale brown, becoming glabrous after ± 2 years; prophylls at base linear-terete, 3–5 mm long, tomentose. *Leaves* scattered, narrowly cuneate, truncate, mucronate, 5–14 cm long, 13–24 mm wide, rather undulate; margins somewhat recurved, dentate-serrate except for 1–3·5 cm from base, the lobes triangular, somewhat oblique, pungently acute, 1–5 mm long; sinuses obliquely U-shaped 2–15 mm wide; lamina above tomentose and shortly hirsute becoming glabrous; tomentose below and hirsute on midrib and main lateral nerves, becoming glabrous, woolly in lacunae; petiole 5–10 mm long, tomentose. *Inflorescence* terminal to short lateral leafy branchlet from stems usually 3–5 years old, pendulous, broadly cylindrical or barrel-shaped, ± 7 cm diam. at anthesis. *Axis* 5–9 cm long, 8–10 mm wide, 23–25 mm wide with common bracts, bearing flowers throughout. *Involucral bracts* rather sparse, linear-terete on somewhat thickened bases, 2–5 mm long, tomentose, brown, persistent until flowering. *Common bracts* linear, ± 7 mm long, densely hirsute; exserted apex flat or slightly convex, very short, tomentose, dark brown. *Floral bracts* similar but slightly shorter and narrower. *Flowers* cream at base grading through pink to deep red in upper half including limb; styles cream. *Perianth* 30–33 mm long including limb of 8–9 mm, straight, not bent below limb before anthesis; claws filiform, 0·5 mm wide, glabrous on both sides; limb ± oblong, slightly thickened upwards with apex incurved, keeled, obtuse, glabrous. *Anthers* ± 5 mm long on filaments of 0·5 mm, apiculate. *Hypogynous scales* triangular, obtuse, 0·5 mm long. *Pistil* 30–32 mm long, straight, glabrous except a few hairs at base; pollen-presenter 6 mm long, fusiform-terete, somewhat narrowed towards base where slightly constricted, finely ribbed, minutely muricate; apex compressed, obtuse; stigmatic groove fine, slightly oblique; ovary shortly hirsute about apex, otherwise glabrous. *Infructescence* rather massive; old perianths and styles persistent. *Follicles* up to 25, prominent, in plan view elliptic-ovate, 35–40 mm long, 22–25 mm high, 15–25 mm wide; valves ± semi-circular but curved to stylar side, convex, thick at base, slightly narrowed, then curved to suture, slightly rugose, densely tomentose; ridge rounded; suture fine; follicles opening usually with fire,

to 20 mm, slightly recurved; valves split from stylar point leaving lateral beak; lips 1·5–2 mm wide, even. *Seeds* broadly obovate, 43–47 mm long; seed body cuneate, obtuse at base, 14–15 mm long, 16–17 mm wide, lateral margins slightly convex, narrowly flanged; upper margin raised inside, convex, narrowly winged; inner face flat, smooth, dark brown-black, somewhat glistening; outer face convex, pale brown with black-brown irregular acute ridges erupting through epidermis; wing 25–32 mm wide, curved to stylar side where broadly slit leaving secondary obtuse lobe. *Separator* obovate, 40–42 mm long, 25–30 mm wide, robust, obtuse at base, flat and smooth against seed body, with a thickened, overhanging ridge above, a thick beak to stylar point; wings strongly recurved.

Distribution. (Fig. 67) South West Western Australia: near the south coast from South Stirling to the West River and inland to Pingrup.

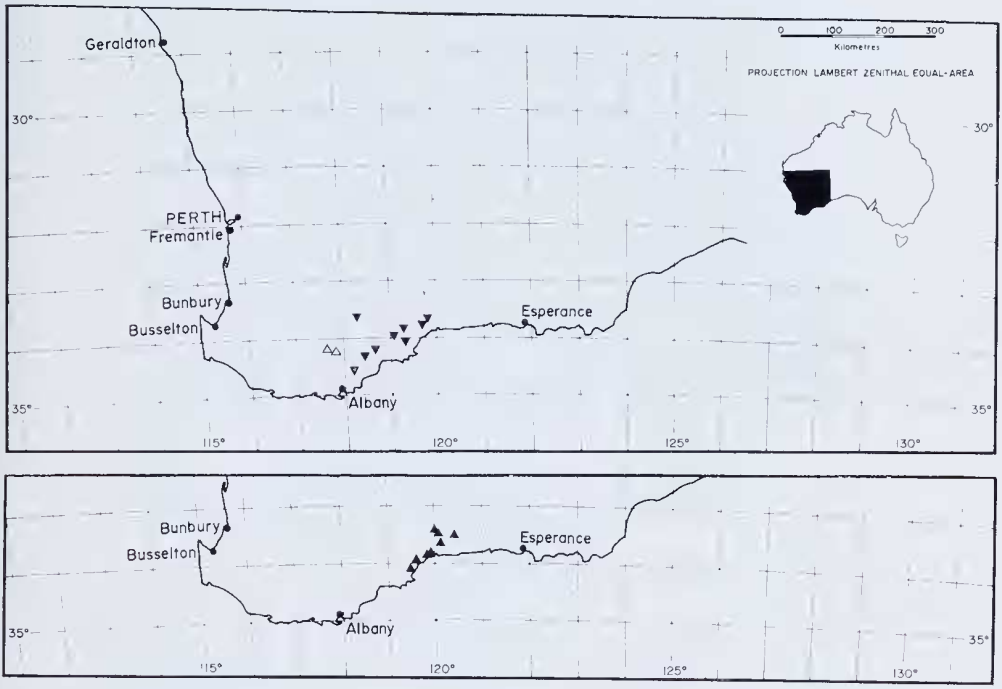


Figure 67. Distribution of *Banksia lemanniana* (▲), *B. caleyi* (▼), and *B. aculeata* (△).

Selected collections. SW of Pingrup, 12 Nov. 1968, *A. M. Ashby* 2745 (AD, CANB, LE); SW Australia, no date, *Maxwell* s.n. (MEL); 32·6 miles (48 km) SE of Borden on Bremer Bay road, 27 Nov. 1960, *A. S. George* 1721 (PERTH); Fitzgerald River, 12 Nov. 1935, *C. A. Gardner* s.n. (PERTH); 24·5 miles (40 km W of Ravensthorpe, 1 Dec. 1960, *A. S. George* 1873 (PERTH).

Habitat. In white-grey sandy loam on plains, in tall open shrubland usually with mallee *Eucalyptus*.

Flowering period. Late October to December.

Banksia caleyi is locally common over much of its range but in spite of having red flowers is not a spectacular plant. The rounded shrubs are bushy and conceal their flowers within the foliage where they are probably pollinated by small marsupials—a contradiction of the theory that red flowers are bird-pollinated. The pungently dentate leaves provide something of a barrier to animals attempting to enter the shrub except at ground level. The red colour of the perianth in fact is most intense during bud development: it becomes dull and pinkish as the flowers open.

Besides its red flowers, the species differs from *B. lemanniana* in its rounded, bushy habit, its longer, narrower, more pungently dentate leaves and its smoother follicles.

The type collection was probably gathered by Baxter near rather than in the Stirling Range, since the species is unknown in the Range itself.

Although Drummond's collection 4, 301, on which Meissner based his var. *sinuosa*, is quite typical of the species, Drummond did in fact collect the taxon described below as *B. aculeata*. He visited the Stirlings briefly in mid-summer of 1843–4, for a longer stay in summer 1846–7, and again briefly in 1848 (Erickson, 1969).

Figure 68. *Banksia aculeata*. Holotype, A. S. George 11299 (PERTH).

47. Banksia aculeata A. S. George, sp. nov. (Figures 68, 69 and 70)

Banksia caleyi R.Br. affinis, a qua foliis angustioribus canaliculatis lobis paucioribus majoribus; perianthiis longioribus ad basin rubris supra cremeis; pistillis longioribus; folliculis altioribus, crassioribus aequaliter convexis; seminis corpore in epiderme exteriore non erupto; et florescentia serotiniora, differt.

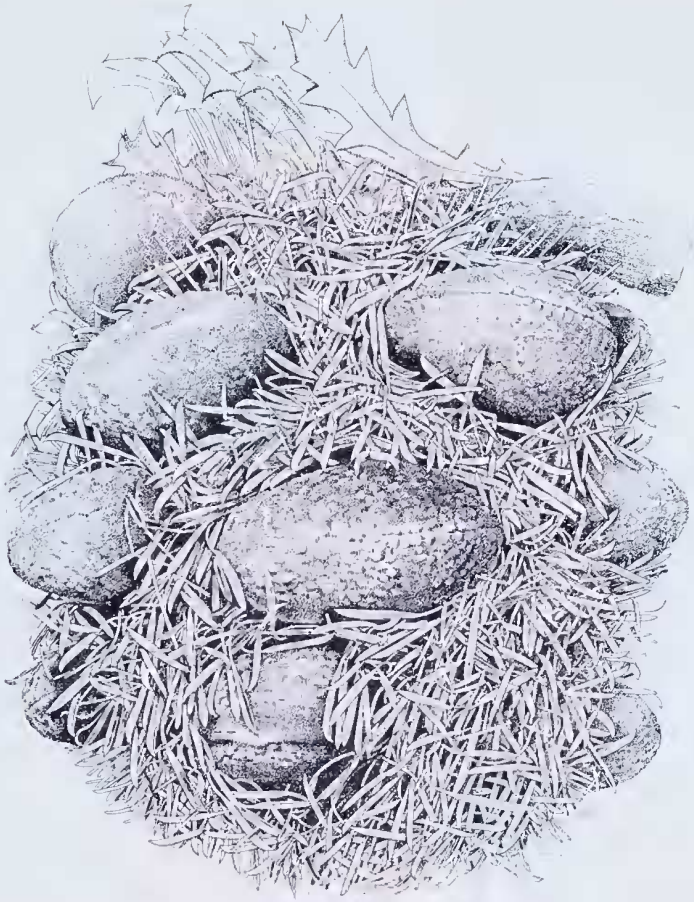


Figure 69. *Banksia aculeata*. Infructescence– x $\frac{1}{4}$. Drawn from A. S. George 6110.

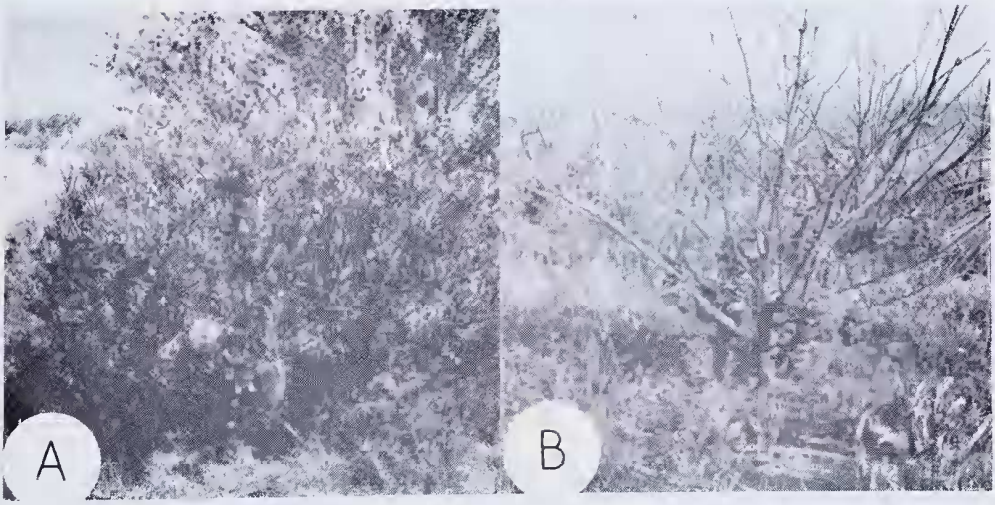


Figure 70. *Banksia aculeata*. A—Habit, 1·7 m tall. B—Plant killed by fire, with open follicles of pendulous infructescences. (Both Stirling Range, W.A.).

Related to *Banksia caleyi* R.Br. from which it differs in the narrower, canaliculate leaves with fewer, larger lobes; the longer perianths reddish at base, cream above; the longer pistils; the taller, thicker, evenly convex follicles; the seed body not ruptured on outer epidermis; and the later flowering period.

Type: E of Cranbrook on Chester Pass road, Western Australia, 20 March 1972, *A. S. George* 11299. Holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH.

Derivation of name. From the Latin *aculeatus*, sharp, in reference to the pungent leaf lobes.

Cotyledons (Fig. 8.41) broadly cuneate, 11–12 mm long, 19 mm wide, spreading, 6–7-nerved and faintly reticulate, dull dark green, sometimes reddish outside, upper margin convex; auricles ± vertical, acute, 3 mm long. *Hypocotyl* thick, glabrous, dark red. *Seedling leaves* first few not recorded; higher leaves ± obovate-oblong, acute, 4–9 cm long, 20–25 mm wide, coarsely serrate, the lobes pungently acute, the distal side convex 3–6 mm long; sinuses V-shaped; margins flat.

Mature plant a shrub to 2 m without lignotuber, much-branched and bushy. *Bark* finely fissured, not friable, grey. *Branchlets* angular-terete, densely tomentose, ferruginous becoming grey, glabrous after 1–2 years; a few linear-terete prophylls near base, densely tomentose. *Leaves* scattered, broadly linear to narrowly cuneate, pungently acute, 4–9 cm long, 8–30 mm wide, usually canaliculate; margins flat or very slightly recurved, serrate on each side with 3–10 rigid pungent lobes up to 1 cm long; sinuses up to 2 cm wide, broadly U-shaped but often angled at lower corner; upper surface of lamina and lower surface on nerves densely tomentose and hirsute becoming glabrous; lower surface with persistent white wool in the fine lacunae; lamina narrowed to petiole of 4–10 mm; new leaves ferruginous. *Inflorescences* terminal to leafy branchlets lateral to stems 2–3 years old, pendulous, cylindrical to barrel-shaped, 8–9 cm diam. at anthesis. *Axis* 6–9 cm long, 10–12 mm wide, 25–28 mm wide with common bracts, bearing flowers throughout. *Involucral bracts* subulate on somewhat thickened bases, 5–10 mm long, tomentose, persistent to flowering. *Common bracts* narrowly cuneate, 8–9 mm long, densely hirsute; exserted apices very short, rounded, densely tomentose, red-brown around margin, almost black in centre. *Floral bracts* similar but narrower and slightly shorter. *Flowers* pink at base grading to cream including limb; styles cream. *Perianth* 30–43 mm long, including limb of 10–12 mm, straight; claws filiform, 0·5 mm wide at base, carinate, quite glabrous; limb narrowly oblong, slightly thickened upwards, prominently keeled, the apex incurved, obtuse, glabrous. *Anthers* 6 mm long on filaments of 0·5 mm, apiculate. *Hypogynous scales* linear, acute, bilobed, 3 mm long. *Pistil* 30–42 mm long, straight, glabrous; pollen-presenter 6–8 mm long, linear-terete, finely ribbed and minutely muricate, the apex obtuse, compressed; stigmatic groove terminal, very fine; ovary hirsute about apex, otherwise glabrous. *Infructescence* massive; old perianths and styles persistent. *Follicles* up to 20, prominent, in plan view broadly elliptic, 30–45 mm long, 25–30 mm high, 20–25 mm wide; valves ± semi-circular but enlarged slightly on stylar side, ± evenly convex, very thick, somewhat rugose, closely tomentose, dark brownish-grey; ridge rounded; suture fine; follicles opening usually with fire, to 20 mm across; valves slightly recurved, split from stylar point leaving a beak: lips 1·5–2 mm wide, even. *Seeds* obovate, 40–50 mm long; seed body broadly cuneate, rounded at base, 10–12 mm long, 15–18 mm wide, lateral margins ± straight, narrowly winged; upper margin thickened on inner side, narrowly winged; inner face flat, smooth or slightly rugose, black, somewhat glistening; outer face convex, slightly wrinkled, pale brown but dotted with tiny brown shining granules; wing 28–35 mm wide, the upper part curved to stylar side where deeply split leaving secondary obtuse lobe. *Separator* similar to seed in shape and size, robust, flat and smooth against seed body, thickened above with an overhanging ridge on each face, broadly beaked to stylar point; wings recurved.

Distribution. (Fig. 67) South West Western Australia: endemic to the Stirling Range.

Selected collections. Western Australia, *J. Drummond* s.n. (MEL); Cranbrook-Chester Pass road, 5 March 1967, *F. W. Humphreys* (PERTH); Between Yetemerup and Red Gum Pass, 7 Oct. 1902, *A. Morrison* (E).

Habitat. In gravelly sand in open to closed shrubland, on plains.

Flowering period. February to March.

Banksia aculeata is very close to *B. caleyi* R.Br. but is sufficiently distinct in the characters given in the diagnosis to be given specific rank. Noteworthy features are the canaliculate leaves, not seen in any other species of the genus; and the perianth limb, anthers and pollen-presenter, all the longest in the genus. Whether the species has evolved from *B. caleyi* or from an ancestor common to it is open to conjecture. It is much more restricted in distribution though locally common.

The late summer flowering period is very brief, but coming when little else in the area is flowering would, through the pollen and nectar, provide a valuable food source for the pollinator. Also flowering in the Stirling Range at this season are *B. sphaerocarpa* var. *sphaerocarpa* and *B. nutans* var. *cernuella*. The three taxa occupy different habitats.

Series **Coccineae** A. S. George, series nova.

Frutices sine lignotuberis. *Caules* erecti. *Folia* late oblonga-obcordata. *Bracteae communes* et *florales* lineari-subulatae. *Flores* sub anthesin verticaliter seriales. *Pistillus* perianthium multo excedens; pollinis praebitor conicus. *Folliculi* perparvi, post dehiscentia cum rostro laterali.

Type species: **Banksia coccinea** R.Br.

Derivation of name From the Latin *coccineus*, searlet, in referenee to the styles of the type (and only) species.

Shrubs without lignotubers. *Stems* erect. *Leaves* broadly oblong-obcordate. *Common* and *floral bracts* linear-subulate. *Flowers* at anthesis vertieally seriate. *Pistil* much exceeding perianth; pollen-presenter eonical. *Follicles* very small, after dehiseence with a lateral beak.

This series contains only one species, *Banksia coccinea* R.Br., which in the distinguishing characters outlined above is so unusual as to warrant its own series. In the subgenus *Banksia* the spiral arrangement of the flowers is usually evident through to anthesis, but in two species of the series *Quercinae*, in the series *Coccineae*, and in five species of the series *Spicigerae* a vertical alignment is superimposed on the spiral pattern during bud development and is often prominent at anthesis. It is further emphasised in *B. coccinea* by the wider spacing of the rows, in addition to which the upper parts of the styles prior to anthesis cross over; the latter occurs also in the series *Spicigerae*. The erect, rather openly branched habit, the broad leaves and the very small follicles are also characters unique to the series.

48. Banksia coccinea R.Br.

Trans. Linn. Soc. London 10:207 (1810)—*Sirmuellera coccinea* (R.Br.) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: in campis prope littora. (ubi v.v.)". Lecto (here chosen): BM, annotated by Brown "King George III Sound Princess Royal Harbour especially near the observatory Dec. 1801". Iso: BM, MEL.

Banksia purpurea Schnitzl., Icon. fam. nat. reg. veget. etc. 2: tab. 113, figs. 33–36, 38 (1849), nomen nudum.

Cotyledons (Fig. 8.42) cuneate-obovate, ascending, 8–9 mm long, 5–6 mm wide, coneave, thick, ± nerveless; auricles ± horizontal, obtuse 1 mm long. *Hypocotyl* ± 1 cm long, 1·5 mm thick, glabrous. *Seedling leaves* crowded immediately above eotyledons; first 2 linear-spathulate in outline, acute or obtuse, 8–12 mm long, the apex triparte with linear acute lobes 2–3 mm long; margins recurved; lamina loosely hirsute above, and on midrib below, loosely woolly below, sessile; next 2–4 leaves similar but up to 17 mm long, 1–2-lobed each side, the lobes narrowly triangular; upper leaves narrowly obovate, up to 4 cm long, 14 mm wide, divided almost to midrib into obliquely triangular obtuse but shortly mucronate lobes up to 5 mm long; sinuses narrowly V-shaped; indumentum as in first leaves but longer and more dense, especially the wool on the undersurface. *Seedling stem* densely hirsute and tomentose.

Mature plant a shrub or small tree without a lignotuber, 1-stemmed at base, erectly branched above, reaching 8 m but usually 2–5 m. *Bark* 2–5 mm thick ± smooth, grey, without lenticels. *Branchlets* at first 4–7 mm diam., densely tomentose and hirsute with short

curled and long hairs, the latter wearing off after a year or so leaving the branchlet elosely pubescent; triangular-subulate densely hirsute prophylls 3–12 mm long near base of branchlet. *Leaves* broadly oblong, eordate or obeordate, truncate but shortly mueronate, 3–9 cm long, 2–7 em wide; petiole stout, 3–5 mm long, tomentose and hirsute; margins flat or slightly reeurved, dentate, the teeth 1–3 mm long, mueronate; sinuses shallow U- or V-shaped, 3–18 mm across; upper surfaee of lamina densely tomentose-hirsute when young beeoming glabrous; lower surfaee densely tomentose-hirsute, the long hairs very dense on midrib, mostly wearing off leaving under surface closely white-tomentose with short curled hairs and the midrib and main lateral nerves ± glabrous; lateral nerves mostly at 60°–80° to midrib, but towards base up to 105° and towards apex to 50°; retieulation between nerves evident on lower surface; terminal mucro long white-hirsute when young; new growth bright pinkish-brown. *Inflorescence* terminating a usually less than 1 year old branehlet, sessile among leaves. *Axis* narrowly eonical, 3–6 em long, 3–5 mm wide, 9–10 mm wide with braets near apex, 14–17 mm wide at base, bearing flowers throughout exeept at apex. *Involucral bracts* linear-subulate, 1–2·5 em long, densely hirsute, many persistent until fruit, the outer grey, inner pale ferruginous. *Common bracts* linear-subulate, 9–12 mm long, upper surfaee above base glabrous, otherwise hirsute, the lower hairs spirally twisted, the upper ± straight. *Floral bracts* linear-subulate, 5–7 mm long; indumentum as in common braets. *Flowers* grey with white or, in upper flowers of infloreseenee, somewhat ferruginous hairs; style searlet, sometimes orange, pale pink to cream towards base. *Perianth* 30–32 mm long ineluding limb of 3–4 mm; ± straight, the limb before and after anthesis sharply reflexed; elaws ± 1 mm wide at base, tapering to less than 0·5 mm below limb, densely long-tomentose outside with eurled hairs, glabrous inside and in lower half 3-grooved; limb narrowly elliptie. almost acute, densely tomentose outside with some of the apieal hairs dark brown. *Anthers* ± 2 mm long, almost filling eavity, shortly apieulate. *Hypogynous scales* linear-subulate, 1·5 mm long. *Pistil* 4–4·8 cm long, before anthesis sharply reflexed into limb, afterwards ± straight and stiffly spreading, glabrous; pollen-presenter narrowly conieal, obtuse, slightly swollen at base, ± 1·5 mm long; ovary glabrous. *Infructescence* small, 2–4 em long, 2·5–3·5 em wide, ± eonical, the apieal part usually without follicles; perianths and styles deeiduous. *Follices* very small, narrowly elliptie in plan view, 6–8 mm long, 1–2 mm high, 2–3 mm wide, obtuse; valves semi-elliptic but wider towards stylar side, eonvex, closely tomentose, opening usually with fire to 5–7 mm; lips less than 0·5 mm wide; a split on caeh side of stylar point. *Seed* 11–14 mm long; seed body cuneate, 5–7 mm long, 4–7 mm wide, upper side ± eurved but not oblique; lateral margins ± aeutely flanged; inner face eonvex, uneven ly rugose, blaek, ± glistening; outer faee unevenly wrinkled, grey-blaek, ± glistening; wing

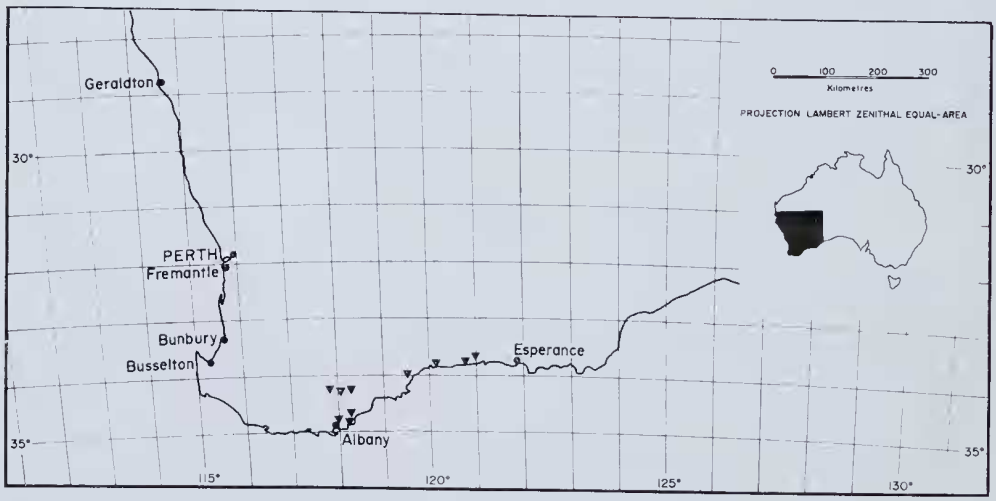


Figure 71. Distribution of *Banksia coccinea*.

slightly oblique, obovate, 6–8 mm wide, often wrinkled, brownish black; usually 1 fertile seed per follicle. *Separator* similar to seed in outline, 11–14 mm long, 7–8 mm wide; base deeply concave next to seed body, relatively thin; wings dark brown, split on stylar side.

Distribution. (Fig. 71) South West Western Australia, from Albany north to the Stirling Range and east to the Young River (between Hopetoun and Esperance). The most inland locality is at the western end of the Stirling Range.

Selected collections. Tolls Pass, Stirling Range, 16 January 1936, *C. A. Gardner*, s.n. (PERTH); Albany, November 1896, *R. Helms* s.n. (PERTH); 38 miles (61 km) E of Manypeaks, 27 May 1964, *A. S. George* 6262 (PERTH); Near Hopetoun, 23 October 1961, *C. A. Gardner* 13704 (PERTH); Ca. 8 km W of Young River crossing on Ravensthorpe-Esperance main road, 29 September 1968, *N. N. Donner* 2815 (AD, PERTH).

Habitat. In deep white or grey sand, usually as a component of tall shrubland associated with such species as *B. baxteri*, *B. attenuata*, *B. speciosa* and *Lambertia inermis*. In the Stirling Range and north-east of Albany it grows in low open-woodland with *Eucalyptus marginata*, *B. attenuata* and *B. ilicifolia*.

Flowering period. June to January with a peak from August to October.

Banksia coccinea is a distinctive species characterised by the short broad leaves, the inflorescence with a prominent, well-spaced vertical alignment of flowers and the follicles which are the smallest in the genus. It has no clear relatives in the genus and is therefore placed in its own series. There is considerable variation in the shape and size of the leaves and in the size of the inflorescence and infructescence. The dominant flower colour of the inflorescence comes entirely from the styles which are typically scarlet but vary to deep red, orange-red and, occasionally, pale orange. The plants are usually shrubby but, near Albany, often reach the size of a small tree.

The species is locally common throughout its range often forming large populations. It is well represented in the Stirling Range and Fitzgerald River National Parks where it should be able to survive with adequate management. In the former park, however, the introduction of *Phytophthora cinnamomi* has led to the destruction of several populations.

Section **Oncostylis** Benth.

Fl. Austral. 5:542 (1870).

Leaves with the margins usually revolute or recurved, the lower surface if exposed closely white-tomentose without evident reticulum. Development of inflorescence usually basipetal. *Pistil* hooked at apex and remaining so after anthesis. *Follicles* without lateral beak after opening. *Cotyledons* obovate, usually narrow.

The section is easily recognised by the hooked apex to the pistil. In all species except *B. nutans* R.Br. the development of the inflorescence is basipetal. The series probably developed early from a *Salicinae*-like ancestor, spreading across southern Australia and, following the onset of aridity across the Nullarbor, speciating in the South West especially.

The section contains three series—*Spicigerae* (7 species), *Dryandroideae* (1 species), and *Abietinae* (13 species).

Series **Spicigerae** A. S. George, series nova

Frutices cum vel sine lignotuberis, vel *arbores* aut ab igni interfectae aut ignem resistentes. *Caules* erecti. *Folia* verticillata vel sparsa, anguste ad late linearia, aliquando anguste elliptica, integra ad breviter dentata marginibus revolutis ad recurvis. *Inflorescentia* cylindrica, plerumque 10–20 cm longa. *Folliculi* anguste elliptici, aliquando oblongi ad rhombici.

Type species: **Banksia spinulosa** Smith

Derivation of name. From the Latin *spica*, a spike, and the suffix *-ger*, bearing, in reference to the cylindrical inflorescences.

Shrubs or *trees* with or without lignotubers or fire-tolerant stems. *Stems* erect. *Leaves* whorled to scattered, narrowly to broadly linear, sometimes narrowly elliptic, entire to shortly dentate or pinnatifid, the margins revolute to recurved. *Inflorescence* cylindrical, usually 10–20 cm long. *Follicles* narrowly elliptic, sometimes oblong to rhombic.

The series contains seven species, two in eastern Australia— *B. ericifolia* L.f. and *B. spinulosa* Smith—and five in the South West—*B. brownii* Baxter ex R.Br., *B. littoralis* R.Br., *B. occidentalis* R.Br., *B. tricuspis* Meissner and *B. verticillata* R.Br. It thus provides a link between east and west, which is clearly evident in *B. spinulosa* (especially var. *cunninghamii*) and *B. occidentalis*. *Banksia littoralis* and *B. verticillata* are closely related to *B. occidentalis*, but the other two species—*B. ericifolia* and *B. tricuspis*—are more distinct.

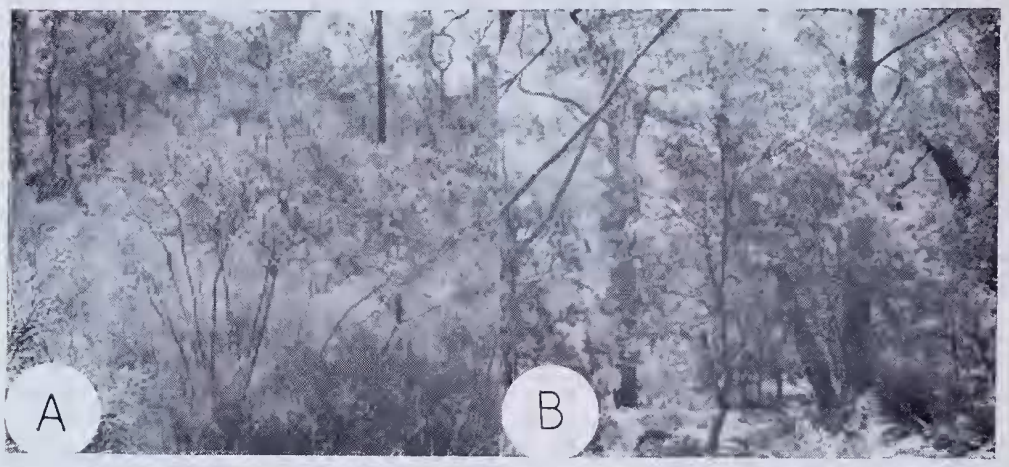


Figure 72. A—*Banksia spinulosa* var. *collina*. Habit, 1·5 m tall showing several stems arising from lignotuber (N of Kew, N.S.W.). B—*B. spinulosa* var. *cunninghamii*. Habit, ± 6 m tall, showing single stem (Scalers Cove, Wilsons Promontory, Vic.).

49. Banksia spinulosa Smith (Figure 72)

Spec. Bot. New Holl. 13, tab. 4 (1 Oct. 1793)—*Sirmuellera spinulosa* (Smith) Kuntze, Rev. Gen. Pl. 2:582 (1891).

Type citation: none given with the protologue. In the Preface to the work, Smith stated that the figures were made from drawings "by John White Esq. Surgeon General to the Colony (i.e. New South Wales), along with a most copious and finely-preserved collection of dried specimens, with which the drawings have in every case been carefully compared." Lecto (here chosen): LINN (162.2), annotated by Smith "Banksia spinulosa" "New South Wales, Mr. White, 1793". The upper right-hand specimen is selected as lectotype.

Cotyledons (Fig. 9.45) obovate, sometimes slightly oblique, not widely spreading, 8–10 mm long, 4–6 mm wide, convex, 3-nerved, bright green; auricles descending, acute, 2 mm long. *Hypocotyl* slender, pale red, glabrous. *Seedling leaves* scattered; the first 3–5 mm above cotyledons, linear, 9–35 mm long, 2·5–5 mm wide, sessile: margins slightly recurved, acutely serrate, sometimes sparsely, the teeth 0·5–1·5 mm long, mucro upturned; upper surface and midrib below loosely hirsute with long white hairs but soon glabrous; lower surface white-woolly: higher leaves 2–12 cm long, up to 1 cm wide, almost flat, acutely dentate almost to base; indumentum as in first leaves. *Seedling stem* loosely hirsute with white hairs becoming glabrous. Lignotuber beginning development within a year in var. *spinulosa* and var. *collina*.

Mature plant a shrub either multi-stemmed with a lignotuber and up to 3 m tall (var. *spinulosa*, var. *collina*) or single-stemmed without a lignotuber and up to 5 m tall (var. *cunninghamii*). *Bark* 2–3 mm thick, smooth with lenticels or becoming somewhat tessellated, grey or grey-brown. *Branchlets* whorled, ± angular becoming terete, tomentose

to hirsute with both short, curled and long, ± straight hairs, the short hairs the more persistent but stem becoming glabrous after 1–2 years, red-brown turning grey-brown; lenticels developing after 1–2 years. *Leaves* narrowly to broadly linear, obtuse to truncate, mucronate, usually 3–12 mm long, 1·8(11) mm wide; margins revolute, recurved or almost flat, usually shortly serrate with mucronate teeth at least in upper part, rarely entire: petiole 1–3 mm long, often the lamina decurrent as narrow ribs; upper surface hirsute with straight, white hairs when young, soon glabrous but smooth to finely scabrous; midrib loosely hirsute below with both long and short hairs but soon glabrous; lower surface concealed or conspicuous, white-tomentose with white or pale brown fine matted hairs; lateral nervation obscure or evident. *Inflorescence* cylindrical, 6–7 cm wide at anthesis, terminating a branchlet usually 3–6 years old, but sometimes 2 or 3 adjacent "nodes" producing inflorescences in the same year; a whorl of branchlets below. *Axis* 6–15 cm long, 4 mm wide, 11–12 mm wide with common bracts; lowest 1 cm without flowers. *Involucral bracts* numerous, mostly persistent until anthesis; subulate from thick bases, ± stiff, 5–10 mm long, tomentose-hirsute with both short and long grey-brown hairs. *Common bracts* narrowly cuneate, 4 mm long, 3 mm wide, ferruginous-hirsute, the exserted apex flattened, thick, obtuse, upturned, shortly pubescent with straight hairs, pale green, grey or pale brown, often vertically striate. *Floral bracts* similar but the apex shorter, narrower and rounded. *Flowers* yellow or golden with the styles yellow throughout or deep red to purple-black in upper half to two-thirds. *Perianth* 23–29 mm long including limb of 3–3·5 mm; claws filiform, pubescent to appressed-hirsute outside, or the midrib glabrous towards base, appressed-pubescent inside in upper 2/3 with straight hairs especially on margins; limb reflexed at anthesis, narrowly elliptic, appressed-pubescent. *Anthers* 2 mm long, apiculate. *Hypogynous scales* ovate-oblong, obtuse or truncate, entire or obscurely lobed, 0·5–1 mm long. *Pistil* 30·45 mm long (base to top of curve), projecting ± 12 mm after anthesis, gradually narrowed upwards, glabrous, the apex strongly hooked through 180°; pollen-presenter slightly thickened to narrowly ovoid, 0·5 mm long; stigmatic groove lateral at apex (on incurved side); ovary with ring of straight, ferruginous (rarely white) hairs around apex. *Infructescence* with up to 100 follicles; involucral bracts and styles mostly deciduous within a year; perianths persistent or at length deciduous (especially in northern populations); young follicles green, shining, turning dark grey-brown then grey; common bracts and floral bracts indurated. *Follicles* in plan view oblong, elliptic or rhombic but often angular and irregular due to crowding, 10–24 mm long, 5–7 mm high, 3–14 mm wide, often shouldered or flanged along each side, then sloping to suture which is very fine; valves slightly wrinkled, pubescent at first but soon glabrous where exposed; follicles opening either with fire or spontaneously, to 2–6 mm wide (sometimes up to 15 mm); lip 1 mm wide in centre broadening to 2–3 mm at sides. *Seed* obovate, 12–20 mm long; seed body ± semi-elliptic to obovate, oblique, 6–10 mm long, 3–5 mm wide, acute or obtuse at base, both surfaces smooth or a little rugose, dark brown to black; wing 6–12 mm wide, ± even, thin, dark brown. *Separator* similar to seed in shape and size, slender, impressed against seed body, slightly thickened above; wing a little recurved.

Banksia spinulosa is a complex species widely distributed near the east coast of Australia from Atherton in North Queensland to Wilsons Promontory in Victoria. Its characteristics include the scattered, linear, usually dentate leaves, the cylindrical inflorescences; green common bracts; pubescent perianths; prominent styles; and flat-topped or convex, flanged follicles. Three varieties are recognised here but each is variable and some populations do not readily fit into any of them.

49A. Banksia spinulosa Smith var. **spinulosa**

B. incognita Anonymous, Nat. Pocket Mag. 1, 18: sp. 3 (1798).

Type citation: none. The plate is here selected as lectotype.

B. denticulata Dum.-Cours., Bot. Cult. (Ed. 2) 7: 108 (1814).

Type citation: none. A sheet at K is annotated with this name and a printed label "New Holland Herb. Forsyth. Purchased 1835".

Shrub with lignotuber. *Leaves* narrowly linear; margins revolute, usually finely serrate only towards apices, without prominent venation. *Branchlets* tomentose, if hirsute, then the long hairs usually wearing off within a year.

Distribution. (Fig. 73) New South Wales and Queensland, in several disjunct areas: North Queensland between Mossman and Ravenshoe; central east Queensland between Coria Bay and Gladstone, with inland outliers on the Blackdown Tableland and south of Biloela; south east Queensland near Gympie and Brisbane; New South Wales from about the Colo and Hawkesbury Rivers south almost to the Victorian border. Except for the outliers in central Queensland the variety is always within 100 km of the coast.

Selected collections. QUEENSLAND: Eluma Ck. Rd., ca. 4 km NE of Julatten, 20 June 1976, *V. K. Moriarty* 2099 (QRS); Wallum Mt., W of Atherton, 14 April 1975, *A. S. George* 12976 (AD, BRI, CANB, MEL, NSW, PERTH); Byfield, near Keppel Bay, 25 Sept. 1931, *C. T. White* 8194 (BRI); Blackdown Tableland, Sept. 1937, *H. G. Simmons* (BRI).

NEW SOUTH WALES: Cheltenham, 30 July 1950, *L. A. S. Johnson* (NSW); Near Mt. Banks, Blue Mts., 9 June 1974, *A. S. George* 11791 (CANB, NSW, PERTH); Lower slopes of Mt. Budawang, about 10 miles (16 km) ESE of Braidwood, Southern Tablelands, 28 Sept. 1965, *L. A. Craven* 574 (B, G, NBV); Jingamy Ck., 6 miles (10 km) N of Eden, 11 June 1960, *E. F. Constable* (NSW).

Habitat. In sand, loam or clay-loam, often rocky (sandstone, sometimes granite) on flats or hillsides, sometimes seasonally damp, in open-forest and woodland. Occurs on both the coastal plain and adjacent mountains.

Flowering period. April to July, sometimes later.

The typical variety of *B. spinulosa* is recognised by its lignotuberous habit and narrowly linear leaves that are shortly serrate towards the apices. It is usually 1–2 m tall but if not burnt can reach 3 m. The only difference from var. *collina* is in the leaves, but this is relatively consistent.

From the Sydney region (where the type was collected) to the Victorian border the variety is relatively uniform, with some variation in the size of leaves, inflorescences and follicles. Between Sydney and Newcastle there is a clinal change to var. *collina* (q.v.). In Queensland the variety is variable, usually having longer leaves that are not so tightly revolute. Intermediates with var. *collina* are common in the South East, but there is no correlation with distribution. On the Atherton Tableland the plants tend to have a sparser indumentum, and the perianths are often deciduous from the infructescence within a few years.

49B. Banksia spinulosa Smith var. **collina** (R.Br.) A. S. George, stat. et comb nov. (Figure 72A)

Basionym: Banksia collina R.Br., Trans. Linn. Soc. London, 10:204 (Feb. 1810)—*Sirmuellera collina* (R.Br.) Kuntze, Rev. Gen. Pl., 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ orientali; in collibus apricis prope littora. Hunter's River, (ubi v.v.)". I have not located a Brown collection; indeed, according to his manuscripts at BM he did not make one—"specimina colligere neglexi". I therefore select as neotype a specimen on a sheet at BM labelled by Brown "Banksia collina prodr. Newcastle Mr. Caley:. The lower, right-hand specimen on this sheet is the neotype. Newcastle is at the mouth of the Hunter River.

B. guentheri Regel, Ind. Sem. Hort. Petrop. 37 (1857).
Type citation: none given; apparently based on material cultivated in Leningrad. The neotype, here nominated, is a sheet at K labelled "Banksia Guntheri Regel χ t. Australia subtropica occidentalis" to which has been added "Gartenfl. 1858—collina R.Br." and "Berlin Bot. Garden Jan. 1884". This is the only sheet I have seen with this name and it agrees with the protologue.

Shrub with lignotuber. *Leaves* linear to narrowly obovate, flat with recurved margins, acutely serrate for most of length; lateral venation evident on both surfaces, at least when dried.

Distribution. (Fig. 73) Queensland and New South Wales; from Nambour, Q., south to the Hawkesbury River, N.S.W.

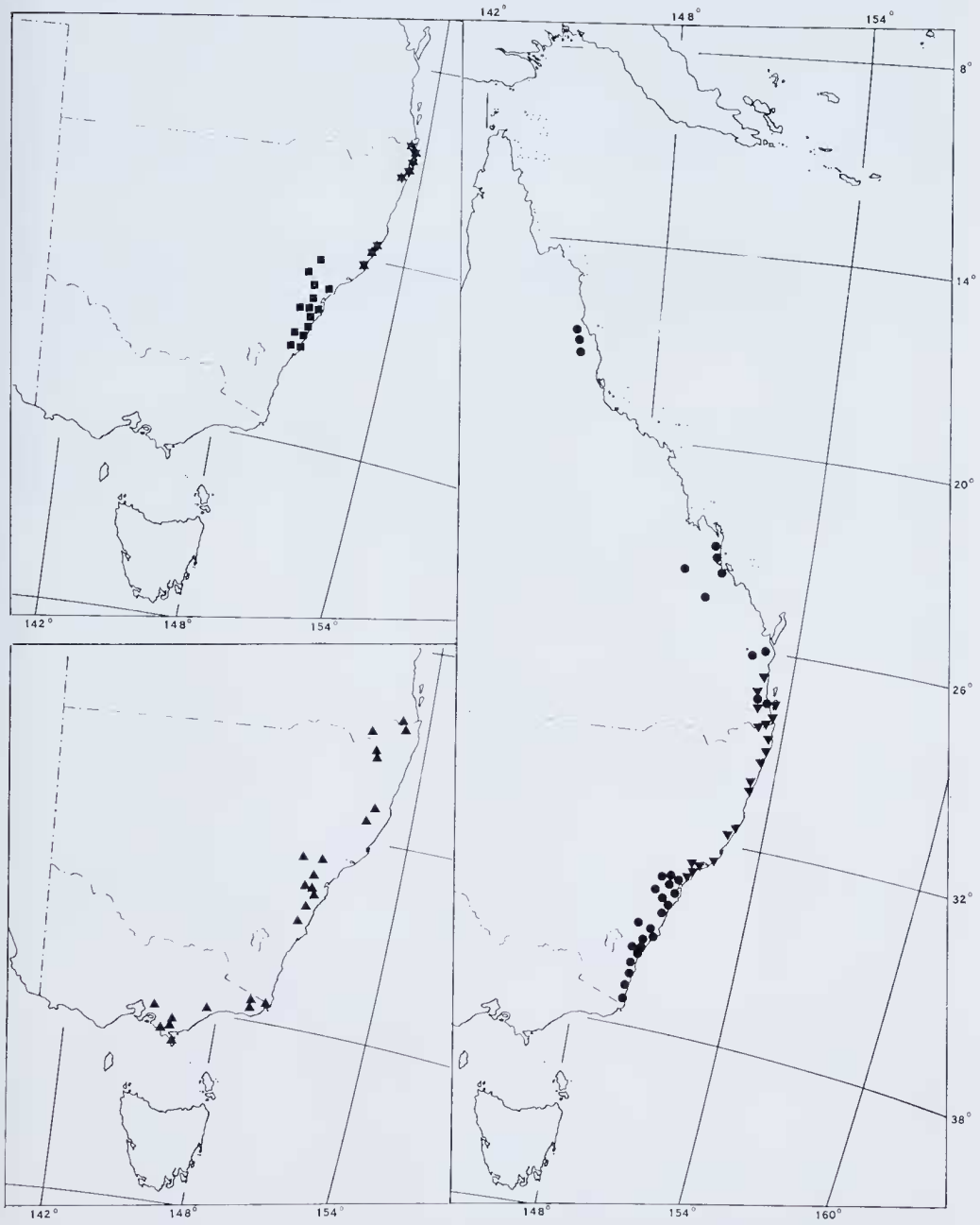


Figure 73. Distribution of *Banksia spinulosa* var. *spinulosa* (●), *B. spinulosa* var. *collina* (▼), *B. spinulosa* var. *cunninghamii* (▲), *B. ericifolia* var. *ericifolia* (■), and *B. ericifolia* var. *macrantha* (★).

Selected collections. QUEENSLAND: Carnarvon National Park, approx. 60 miles (100 km) W of N from Injune, 30 June 1965, *G. Trapnell & K. Williams* 129 (BRI); Mt. Tibrogargon, on lower slopes, 23 July 1974, *F. D. Hockings* (BRI); Chermside, about 5 miles (8 km) N of Brisbane, 22 March 1953, *R. Melville* 3415 & *S. T. Blake* (BRI, K, PERTH).

NEW SOUTH WALES: 8 km from Boonoo Boonoo along track to Boonoo Boonoo Falls (C. 25 km NNW of Tenterfield, 15 Sept. 1977, *L. Haegi* 1397 (NSW, PERTH); Barcoongere State Forest, 40 miles (70 km) SE. of Grafton, 30 April 1956, *E. F. Constable* (NSW); Port Macquarie, May 1915, *J. H. Maiden* (NSW); Pacific Hwy., between Moonee Creek & Somersby turnoff, N of Sydney, 7 May 1975, *A. S. George* 13061 (AD, BRI, CANB, MEL, NSW, PERTH).

Habitat. In sand, loam or shale, often over sandstone, in sclerophyllous open-forest and woodland, and in low coastal heath.

Flowering period. April to August.

The var. *collina* is distinguished from var. *spinulosa* by its broader leaves with recurved (not revolute) margins that usually are serrate throughout. Sometimes the margins are almost entire (e.g. Haegi 1397), and then the variety is distinguished from var. *cunninghamii* in N.S.W. by the presence of a lignotuber, the evident leaf venation and the white indumentum on the lower surface of the leaves. Variation in flower colour is the same as that in var. *spinulosa*, i.e. both all-golden and golden with dark red or purple styles.

Northern populations mostly have longer leaves than southern ones. In south-east Queensland there is an overlap in distribution with the northern populations of var. *spinulosa*. At the southern end of its range, near the Hawkesbury River, var. *collina* shows a sudden clinal change to var. *spinulosa*. A representative collection is George 13062, collected near Moonee Creek N of Sydney, which has narrow leaves with recurved margins giving it an aspect intermediate between the two varieties.

Occasionally the branchlets remain hirsute for some time as in var. *cunninghamii*, e.g. Wyong, G. Betche (NSW 138044).

A specimen of Boorman (NSW 138065) bears one of the earliest references by a collector to the lignotuberous habit—"as many as a dozen (stems) which all issue from the stool".

49C. Banksia spinulosa Smith var. **cunninghamii** (Sieber ex Reichb.) A. S. George, stat. et comb. nov. (Figure 72B)

Basionym: Banksia cunninghamii Sieber ex Reichb., Iconog. Bot. Exot. 58, t. 81 (Jan.-Jun. 1827).

Type citation: "Sieber Flor. Nov. Holl. exsicc. no. 6." "Habitat in montium coeruleorum declivibus occidentalibus prope montem York. Floret a mense Augusto ad Octobrium usque." The figure is of a "specimen a cl. Siebero lectum". Seven sheets have been located; that at K is selected as lectotype. It is from the Hookerian herbarium and has a Sieber printed label. The other sheets (isotypes) are at AWH, B, BM, MEL, OXF, P and S.

non *B. cunninghamii* Sieber ex Spreng., Linn. Syst., 16th ed., Cur. post. 47 (Jan.–June. 1827).

nec *B. cunninghamii* Sieber ex Schultes et Schultes f., Linn. Mantissa 3: 289 (Jul.–Dec. 1827).

B. ledifolia Cunn. ex Meissner in DC. Prodr. 14: 454 (Oct. 1856). Nomen nudum, cited in synonymy under *B. cunninghamii*.

B. prionophylla F. Muell., First Gen. Rep. Veg. Col. 17 (Oct. 1853) nom. nud. et in Linnaea 26: 353 (1853).

Type citation: "Australia felix". Lecto (here chosen): MEL, labelled by Mueller "Banksia prionophylla fer v Mueller. B. cunninghamii Sieber? Austr. felix".

"*B. littoralis* Lindley", Index Kew. 1: 271 (1895). The reference is to Bot. Reg. t. 1363 (1830) where Lindley cited *B. littoralis* R.Br., but the plant figured is *B. spinulosa* var. *cunninghamii*. There is at BM a cultivated specimen from Kew corresponding to the plate.

A *shrub* to 5 m without lignotuber, single-stemmed at base. *Branchlets* usually very hirsute. *Leaves* linear or broadly linear, the margins slightly recurved, sometimes loosely revolute, acutely serrate to entire; lower surface closely and evenly tomentose, pale brown, ± nerveless.

Distribution. (Fig. 73) Queensland, New South Wales and Victoria: in south east Queensland a few collections near Stanthorpe and on the Lamington Platcau; in New South Wales along the Great Dividing Range from the Queensland border to the Shoalhaven River; in eastern Victoria from the Dandenongs to Wilsons Promontory and east to the N.S.W. border.

Selected collections. QUEENSLAND: Stanthorpe, no date, *W. R. Petrie* (BRI); Lamington National Park, McPherson Ra., 15 July 1945, *S. T. Blake* 15849 (BRI).

NEW SOUTH WALES: Summit, Mt. Warning, 3 Oct. 1939, *F. A. Rodway* 2976 (NSW); Crossing of the Upper Forbes River, "Hastings River Highway", Mt. Box State Forest, 20 Aug. 1974, *J. Amstrong* 198 (NSW, PERTH); Below Fairy Falls, Wilson Park, Lawson, 3 May 1975, *A. S. George* 13046 (NSW, PERTH) Fitzroy Falls, 21 April 1950, *L. A. S. Johnson* s.n. (NSW).

VICTORIA: ± 18 miles (25 km) NE of Warburton on road to Woods Point, Dandenongs, 22 April 1973, *A. S. George* 11652 (MEL, PERTH); Wilsons Promontory, 1823–29, *W. Baxter* (BM, NSW, PERTH); Road to Wingan Inlet, 1 mile (1·6 km) S of Princes Hwy., near Mt. Drummer, far east Gippsland, 20 Feb. 1965, *J. H. Willis* (MEL); Cape Howe, no date, *S. Hunter* s.n. (MEL).

Habitat. In loam, clay-loam and sand, usually in sclerophyllous closed or open-forest and woodland among tall understorey, often on hillsides; sometimes in rocky (sandstone) soil.

Flowering period. April to July.

I have included this taxon with *B. spinulosa* on the basis of the floral and fruit morphology which are virtually the same in all three varieties of the species. In the field it is usually easy to separate them by the habit, var. *spinulosa* and var. *collina* being lignotuberous and var. *cunninghamii* non-lignotuberous. The latter grows much taller, up to 5 m; the branchlets remain hirsute for some time, and the leaves have a close pale brown indumentum on the lower surface without evident lateral venation. Throughout the genus, however, I have considered taxa as specifically distinct only if there is morphological difference in flowers and/or fruit, usually in addition to differences of habit and leaf form. Since those criteria do not apply with the *spinulosa* complex, and since on the basis of flowering and fruiting specimens the taxon is sometimes uncertain (e.g. Warri National Park, Springbrook area, Webster & Hildreth (BRI 163016)), I regard it as one species with three varieties. All three flower concurrently.

In general plants of var. *cunninghamii* from New South Wales have leaves that are almost or quite entire while those from Victoria are serrate (Mueller's *B. prionophylla*) but there is no other morphological difference. Further, not all populations fit this generalisation, e.g. Wynnes Rocks, Mt. Wilson, N.S.W., E. Constable (NSW 11298) which has dentate leaves, and collections from Wilsons Promontory, e.g. Titania Creek, J. Galbraith (NSW 138070), which have almost entire leaves. The Wilsons Promontory plants often also have revolute margins giving then the aspect almost of var. *spinulosa*, but the habit and indumentum are typical of var. *cunninghamii*.

At several localities in the Blue Mountains var. *spinulosa* and var. *cunninghamii* are sympatric, e.g. Fitzroy Falls, Lawson. No intermediates between these varieties are known.

Several presumed natural hybrids between var. *cunninghamii* and *B. ericifolia* var. *ericifolia* have been recorded, e.g. at Bulls Camp near Linden (George 13038, 13039) and the Pigeon House Range (Gauba).

I have used as the author of *cunninghamii* "Sieber ex Reichenbach", since it is likely that this appeared before the publication by Sprengel. Stafleu (1967) stated that Reichenbach's work was published in decades, and plate 81 therefore was probably early in the period January–June 1827. The relevant volume of Sprengel's edition of the Systema vegetabilium, vol. 4 part 2, was reviewed in June-July 1827 which implies that it was later than Reichenbach's work. The author was cited as Reichenbach by Dietrich (1839). The Schultes' publication appeared in the second half of 1827. All three authors based the name on the same collection, Sieber 6.

Figure 74. *Banksia ericifolia* var. *macrantha*. A—Habit, 3 m tall (note plant of *B. oblongifolia* in front). B—Bark. (Both near Byron Bay, N.S.W.).

50. Banksia ericifolia L.f. (Figure 74)

Suppl. 127 (Oct. 1781) (as *ericaefolia*)—*Sirmuellera ericifolia* (L.f.) Kuntze, Rev. Gen. Pl. : 582 (1981)—*Isostylis ericifolia* (L.f.) Britten, Illustr. Pl. Cook's Voy. 3: 83 (1905).

Type citation: "*Habitat* in Nova Hollandia. *J. Banks.*" Lecto (here chosen): LINN (sheet 162.1) labelled by J. Smith "New Holland—*Banks.* Herb. Linn. fil. Banksia ericifolia (sic) Linn. suppl." Iso: E, NSW, US.

B. phylicaefolia Salisb., Prodr. 51 (1796), nom. illeg., superfl. Type: as for *B. ericifolia* L.f.

Cotyledons (Fig. 9.46) narrowly obovate to oblong, 12–16 mm long, 3–4 mm wide, ± erect, faintly nerved, bright green; auricles descending—spreading, acute, 0·5–1·5 mm long. *Hypocotyl* 1 cm long, slender, glabrous or loosely pilose, pale pinkish-green. *Seedling leaves* opposite to subopposite for several pairs, then scattered, the first 2–3 mm above cotyledons, then ± crowded: first leaves 10–12 mm long, sessile, semi-amplexicaul, linear but widening at base, truncate, shortly mucronate and with one or several short mucronate lobes on the upper margins; margins loosely revolute; lamina sparsely hirsute above but soon glabrous, densely white-pubescent below with crisped matted hairs, midrib sparsely hirsute but soon glabrous. Upper seedling leaves narrower, not amplexicaul, the margins more tightly revolute.

Mature plant a shrub or small tree to 6 m, without lignotuber, single-stemmed at base, much-branched above, forming a dense, often rounded shrub but sometimes open, the branchlets erect or ascending, foliage dark green. *Bark* at first smooth with lenticels, rich brown; lenticels becoming larger and corky and the bark then grey or grey-brown, 4–5 mm thick on mature stems. *Leaves* scattered, crowded, erect or gently recurved, linear, 9–20 mm long, 0·75–1 mm wide, truncate to emarginate, shortly mucronate, the mucro often recurved; a mucronate tooth up to 1 mm long on each side of apex; petiole 1–2 mm long; margins closely revolute, midrib evident in groove below; upper surface when young sparsely hirsute especially along midrib with straight hairs, soon glabrous; concealed lower surface of lamina densely tomentose with crisped hairs, midrib hirsute becoming glabrous; petiole pubescent. *Inflorescence* at apex of a usually 1–3 year old branchlet, with a whorl of lateral branchlets below. *Axis* 7–22 cm long, 3–4 mm wide; 12–15 mm wide with common bracts; lowermost 1–1·5 cm of axis without flowers. *Involucral bracts* narrowly subulate, 2–10 mm long on broad bases, erect to squarrose, finely pubescent with short straight hairs. *Common bracts* broadly cuneate, 4–5 mm long, 3–4·5 mm wide, densely silky; exserted apex upturned, obtuse, striate, appressed-pubescent with translucent hairs, pale green when fresh. *Floral bracts* similar to bracts

but slightly shorter and narrower. *Flowers* golden brown, often mauve towards base, with gold, orange or orange-red styles. *Perianth* 16–28 mm long including limb of 2·5–3 mm which is down-turned before anthesis; claws appressed-pubescent, the hairs a little longer and spreading in upper part, densely hirsute inside along margins, the hairs pointed upwards and inwards, less dense in upper part; limb elliptic, almost acute, pubescent to hirsute, glabrous inside; perianth ± relaxed after anthesis. *Anthers* strongly navicular, 1 mm long; filament short, thick; connective shortly produced. *Hypogynous scales* very narrowly ovate to triangular, obtuse, 3 mm long. *Pistil* 30–48 mm long, down-curved for ± 10 mm below apex and strongly incurved in top 2 mm, glabrous except just above ovary where shortly appressed-pubescent; pollen-presenter ± 0·5 mm long, ovoid, obtuse, keeled below, stigmatic groove along keel; ovary glabrous. *Infructescence* of many follicles, fairly openly arranged, the styles deciduous early but perianths persistent for some years where protected by follicles; involucral bracts persistent; common bracts and floral bracts enlarged somewhat and indurated. *Follicles* somewhat irregular in plan view—oblong, elliptic, trapeziform or rhombic, 13–22 mm long, 6–10 mm high, 4–13 mm wide, the upper surface often convex and then prominently ridged on each side so that in T.S. the follicle is mushroom-shaped; ridge rounded to almost acute, suture very fine; surface smooth to finely wrinkled, densely hirsute with straight hairs, becoming worn off exposed parts; dark brown, yellow-brown or grey; follicles opening 4–8(11) mm; lips 1 mm wide in centre, 2–3 mm at ends; valves slightly recurved; usually 1 viable seed per follicle. *Seeds* obovate, 17–20 mm long; seed body cuneate, straight or oblique at apex, 9–10 mm long, 4–5 mm wide across apex, inner surface ± swollen, irregularly wrinkled in upper part, with fine longitudinal ridges in lower half, black but somewhat shining; outer surface flat, pale grey-brown with irregular pale blotches shining; wing broadly obovate with slight angle on stylar side, 9–11 mm wide, brown, glistening inside, pale grey-brown outside. *Separator* similar in shape to seed but the broadest width 10–12 mm; narrowly cuneate at base for 7–9 mm; acute at base; wings slightly recurved; base and lower half of wings dark brown, upper part paler with scattered vertical dark streaks, dull.

Banksia ericifolia may be recognised by its non-lignotuberous, tall, bushy habit; its crowded, linear, short leaves, its golden-yellow to orange-red flowers; and its follicles with convex upper surfaces.

The species contains two varieties differentiated by the seedling leaves, perianth and pistil length and to a lesser extent perianth indumentum. They are also geographically disjunct.

50A. Banksia ericifolia L.f. var. **ericifolia**

Seedling leaves with 2–6 teeth on each side. *Perianth* 19–22 mm long; limb pubescent. *Pistil* 30–35 mm long.

Distribution. (Fig. 73) New South Wales: central coast and adjacent parts of the Great Dividing Range, from Ellenborough to Jervis Bay; in the mountains extending north to Collaroy.

Selected collections. Collerong, 5 Feb. 1930, *H. K. C. Mair* s.n. (NSW); near summit of Mt. Pindari, Karangra Tops, 30 Oct. 1948, *L. A. S. Johnson* s.n. (NSW); Bulls Camp, near Linden, Blue Mts., 3 May 1975, *A. S. George* 13042 (CANB, NSW, PERTH); "Artillery Hill", Royal National Park, 3 miles (5 km) S of Sutherland, 8 April 1970, *R. Coveny* 2890 (NSW, PERTH); Meryla State Forest near Moss Vale, late April 1959, *D. McGillivray* 888 (NSW); Between Currarong Beach and Point Perpendicular, Jervis Bay, 22 May 1964, *J. H. Willis* s.n. (MEL).

Habitat. In deep sand, sandy loam, or in shallow sand over sandstone; near the coast often a component of tall shrubland, open scrub or open heath, but also in sclerophyllous open forest and woodland, the latter also in montane situations, both on ridges and in valleys; occasionally in semi-swampy places; recorded at altitudes up to 1 100 m.

Flowering period. Mainly April to August.

Figure 75. *Banksia ericifolia* var. *macrantha*. Isotype, A. S. George 13011 (PERTH).

50B. Banksia ericifolia L.f. var. **macrantha** A. S. George, var. nov. (Figures 74 and 75)

Folia plantulae in utroque margine 1– (raro 2–) dentata. *Perianthium* 26–28 mm longum; limbus hirsutus. *Pistillum* 46–48 mm longum.

Type: ± 3 km NW of Byron Bay on road to "Coast to Coast" motel, New South Wales, 28 April 1975, *A. S. George* 13011. Holo: NSW; iso: CANB, PERTH (2 sheets).

Seedling leaves with 1 (rarely 2) teeth on each margin. *Perianth* 26–28 mm long; limb hirsute. *Pistil* 46–48 mm long.

Distribution. (Fig. 73) New South Wales: north coast, from Murwillumbah to near Grafton, but apparently absent between Grafton and Nambucca. There are no collections from Queensland.

Selected collections. Kingscliff, near Murwillumbah, Nov. 1964, *J. Liddy* s.n. (NSW); 1½ miles (2 km) NW of Lennox Head, 12 June 1957, *L. A. S. Johnson & E. F. Constable* (NSW); Trial Bay (mouth of Macleay R.), Aug. 1909, *J. L. Boorman* s.n. (N.S.W.); Cape Hawke, 1884, *C. Fawcett* s.n. (MEL).

Habitat. In deep sand, often low-lying and seasonally damp, as a component of open scrub and tall shrubland; often common; may be associated with *B. oblongifolia* Cav.

Flowering period. April to August.

This variety is separated from var. *ericifolia* mainly on the basis of its larger flowers. The seedling leaves as so far observed have usually one or rarely two teeth on each side, in contrast to the 2–6 teeth of var. *ericifolia.* Usually the leaves of var. *macrantha* are narrower and more crowded than those of var. *ericifolia*, and the flowers are often more deeply coloured, due partly to a ferruginous indumentum. There is one collection with very pale flowers, the indumentum being white—E of Grafton, 3 Sept. 1979, *A. Embury* (NSW 144124)—found among normal coloured plants.

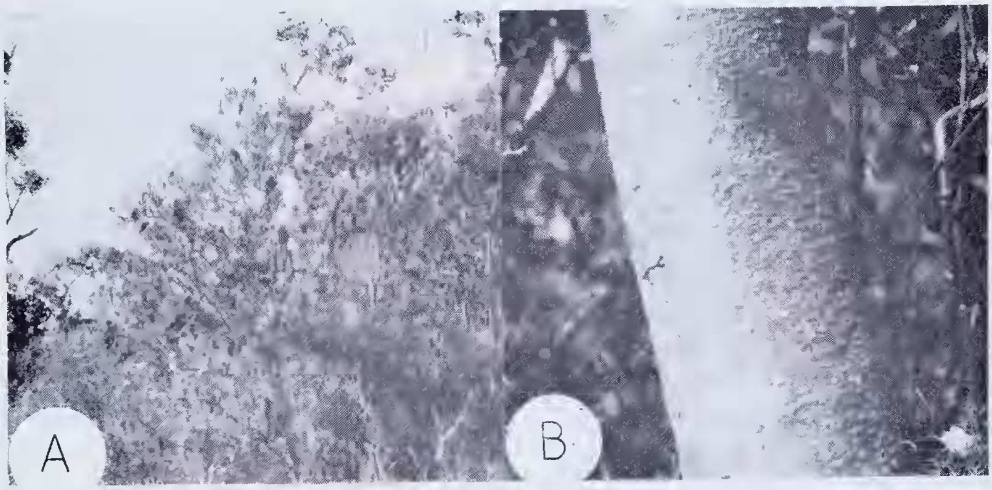


Figure 76. *Banksia brownii.* A – Habit, ± 3 m tall. B—Bark. (Both Millbrook, W.A.).

51. Banksia brownii Baxter ex R Br. (Figure 76)

Prot. Nov. 37 (1830)—*Sirmuellera brownii* (Baxter ex R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891)—as "Brownei (Baxter)".

Type citation: "Ora occid.-merid., regio mont. prope King George's Sound, 1829, *D. Baxter.*" Lecto (here chosen): BM, a sheet labelled by Brown "Banksia Brownii Prodr. Flor. Nov. Holl. suppl. 1. p. . . Inland from King George's Sound 1829 Mr. Wm. Baxter". Iso: BM (including fruit), K.

Cotyledons (Fig. 9.43) obovate, spreading with apices often upturned, 12–13 mm long, 9–10 mm wide, concave, medium green; auricles ± horizontal, acute, 2 mm long. *Hypocotyl* moderately stout, 15 mm long, sparsely hirsute, deep red. *Seedling leaves* first 2 opposite, 13–17 mm above cotyledons, ± oblong but deeply divided into obliquely triangular acute lobes, 14–17 mm long, 6–7 mm wide, widely spreading to recurved; margins slightly recurved; lamina hirsute above, white-tomentose below with the midrib hirsute;

next 2 leaves ± alternate, otherwise similar to first 2; upper leaves again opposite; after 4–8 leaves the lobes narrow and crowded as in adult leaves. *Seedling stem* sparsely hirsute at base, more densely above, red.

Mature plant an erect, bushy shrub to 4 m, occasionally in sheltered gullies a small tree to 6 m, without lignotuber. *Bark* ± thin, smooth with lenticels, grey-brown. *Branchlets* slender, obscurely ribbed, closely pubescent with pale brown curled hairs, becoming glabrous after 2–3 years; a few subulate tomentose bracts on lower 2–4 cm of branchlet. *Leaves* usually whorled, a few sometimes scattered, rather soft, broadly linear-oblong, 3–11 cm long, 5–12 mm wide, retuse with short obtuse tomentose mucro, divided almost to midrib into many (up to 70) linear-falcate lobes: lobes tapering, obtuse, not imbricate at base; sinuses very narrowly V-shaped; margins revolute but not concealing under surface; upper surface sparsely pubescent with crisped hairs, becoming glabrous; lower surface with midrib densely pubescent becoming glabrous, the lamina white-woolly; midrib of each lobe ± glabrous near main axis of leaf; petiole 2–5 mm long, pubescent. *Inflorescence* terminal to a 1–2 year old branchlet, with a whorl of lateral branchlets below, partially concealed; 8–10 cm diam. at anthesis. *Axis* 6–19 cm long, 4–5 mm wide, 16–17 mm wide with common bracts, without flowers for ± 1 cm at base and for a few mm at apex. *Involucral bracts* numerous, subulate-terete on thick bases, 5–18 mm long, closely pubescent, grey and brown. *Common bracts* narrowly cuneate, 6–7 mm long densely hirsute, ferruginous; exserted apex conical but compressed, obtuse, somewhat upturned, closely pubescent. *Floral bracts* similar but narrower with a less prominent apex. *Flowers* cream at base, pale brown above, with grey or grey-brown limb: style cream at base, metallic red above with pale yellow apex; old flowers changing quickly to pale brown throughout. *Perianth* 27–31 mm long including limb of 3 mm, straight with limb sharply downturned before anthesis; claws filiform, 0·5–0·6 mm wide at base, tapering, hirsute outside, glabrous inside in lower half, hirsute along margins in upper half; limb fusiform, obtuse or acute, hirsute outside, more densely towards apex. *Anthers* 1 mm long on filaments of 1 mm, shortly apiculate. *Hypogynous scales* oblong, truncate, 0·7–0·8 mm long, free. *Pistil* 41–50 mm long (base to bend), slightly curved with apex sharply incurved through ± 180°, glabrous; pollen-presenter narrowly ovoid, ± 0·3 mm long; apex obtuse with stigmatic groove oblique on inside of style curve, pale, a reddish-brown band below except for a gap below the stigmatic groove; ovary pubescent in upper half with ferruginous hairs. *Infructescence* stout, 4·5–5 cm diam.: old perianths and styles persistent but gradually breaking away; involucral bracts persistent. *Follicles* up to 60, rather concealed, in plan view narrowly elliptic to linear, 17–25 mm long, 5–10 mm high, 4–7 mm wide; valves semi-elliptic, gently convex, slightly rugose, densely pubescent; ridge very narrow; suture fine; follicles usually opening with fire, to 18 mm across, valves somewhat recurved; lips 3–3·5 mm wide, broadening to 5 mm at ends. *Seed* obovate, 19–20 mm long; seed body ± cuneate, 8–9 mm long, 5–6 mm wide, distal margin oblique, lateral margins slightly convex, obtuse at base, not winged; inner face very convex, with a few irregular ridges, black with some grey, glistening; outer surface slightly convex, irregularly ridged, dark brown; wing 9–11 mm wide, ± even, dark brown. *Separator* obovate-cuneate against seed body, sharply ridged above but not swollen; wings recurved; not beaked.

Distribution. (Fig. 77) South West Western Australia: restricted to the area from Albany to the Stirling Range.

Selected collections. Foothills, Mt. Trio (Stirling Range), 22 July 1952, *N. H. Speck* s.n. (CANB); Summit of Bluff Knoll, 9 Oct. 1978, *K. F. Kenneally* 6953 (PERTH); Near Millbrook, ± 30 km N of Albany, 7 June 1977, *A. S. George* 14584 (CANB, K, NSW, PERTH); 10 miles (16 km) N of Albany, 31 March 1917, *F. M. C. Schock* (PERTH).

Habitat. In shallow sand over laterite in low open-woodland, in shale in gullies in woodland; and in rocky soil among low heath on mountains.

Flowering period. May to July.

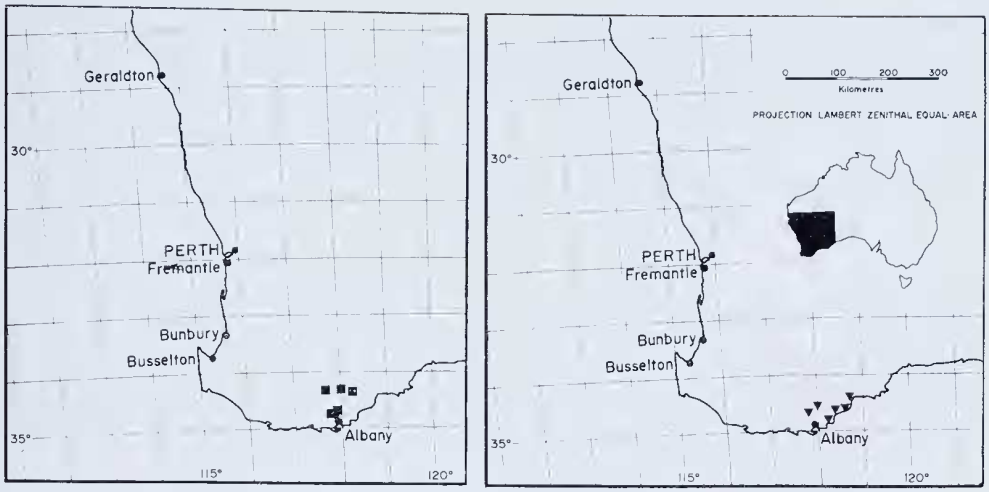


Figure 77. Distribution of *Banksia brownii* (■) and *B. dryandroides* (▼).

Banksia brownii is easily recognised by its whorled, soft, finely pinnatifid leaves with many linear lobes, its large reddish-brown inflorescences and its infructescences with narrow follicles and persistent old flowers. The pistils change colour rapidly at anthesis, the metallic red of the late bud turning to pale brown. The uppermost flowers are usually so fading before the basal ones have reached anthesis.

Although the morphology of leaves, flowers and fruit is fairly uniform, there is variation in habit. The plant is usually an erect, bushy shrub of 2–3 m, but in sheltered gullies may become an openly branched small tree and on some peaks of the Stirling Range is a low, spreading shrub.

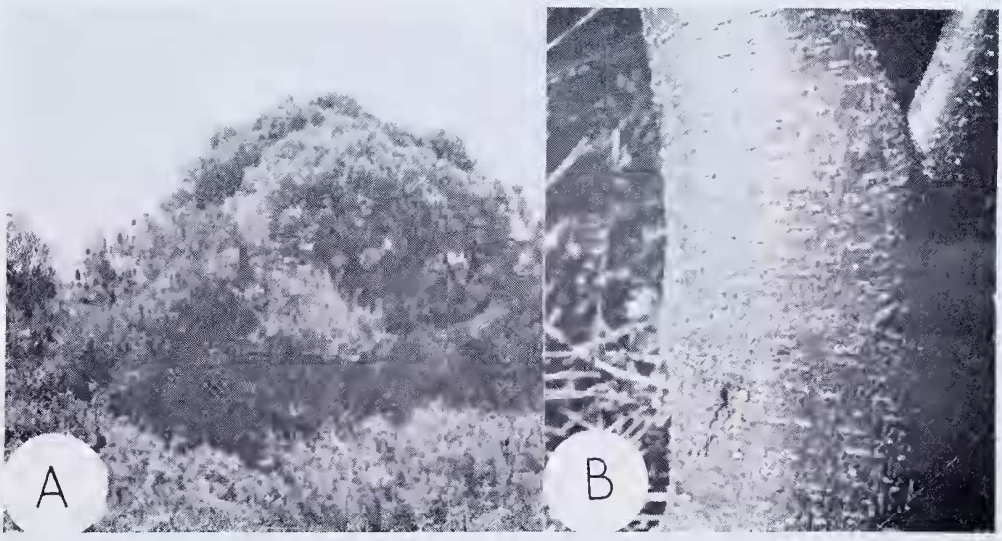


Figure 78. *Banksia occidentalis*. A—Habit, 3 m tall (left) with *B. littoralis* (behind to right). B—Bark. (Both E of Lake Powell, W.A.).

52. Banksia occidentalis R.Br. (Figure 78)

Trans. Linn. Soc. London 10: 172 (Feb. 1810)—*Sirmuellera occidentalis* (R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: in ericetis. (ubi v.v.)". Lecto (here chosen): BM, annotated by Robert Brown with the locality "King George South Between Princess Royal Harbour and the lake towards Cape How"; an additional note gives the date "Dec. 24 1801". Iso: BM, K.

Cotyledons (Fig. 9.47) obovate, 6 mm long, 4 mm wide, widely spreading, upper margin slightly oblique, ± nerveless; margin red; auricles spreading, obtuse, 1 mm long. *Hypocotyl* slender, glabrous, red. *Seedling leaves* opposite; first two 3–5 mm above cotyledons, horizontal, oblong but tapering, obtuse, 7–11 mm long, 3 mm wide, very shortly dentate in upper 1/2, sessile, almost auriculate; upper surface glabrous, lower white-tomentose; higher leaves at nodes, 10–25 mm apart broadly linear, acute to truncate, mucronate, 2–4 cm long, 3–4 mm wide, sessile; margins ± flat, shortly serrate; upper surface loosely appressed-pubescent becoming glabrous; lower surface densely white-woolly, the midrib appressed-pubescent becoming glabrous. *Seedling stem* angular, appressed-pubescent becoming glabrous, reddish.

Mature plant a shrub or small tree to 7 m, without a lignotuber, 1-stemmed at base. *Bark* thin, remaining ± smooth, with prominent lenticels, brown or grey-brown. *Branchlets* whorled, slender, angular, pubescent, becoming terete and glabrous. *Leaves* in whorls of up to 12, the whorls widely spaced in the lower part of the branchlets, more crowded towards apices; lamina narrowly linear to linear, truncate, mucronate, 4–13 cm long, 2–3 mm wide (to 6 mm in one coastal population); petiole 1–5 mm long; margins recurved to revolute, sparsely serrate, rarely entire except for 1–2 teeth near apex; teeth up to 1 mm long with rigid, acute apices directed outwards or forwards; upper surface of lamina and midrib below when young appressed-pubescent with straight hairs, soon glabrous; lower surface densely white-matted, obscuring nervation. *Inflorescence* terminating a usually 2–4 year old branchlet, subtended by up to 8 branchlets and a whorl of leaves; occasionally on older stems. *Axis* 4–14 cm long, 3 mm wide, 10–11 mm wide including common bracts, the lowest 5–10 mm and the apex without flowers. *Involucral bracts* with swollen, triangular bases, the inner ones produced into filiform apices, the whole 2–12 mm long, densely tomentose with both crisped and straight hairs, persistent. *Common bracts* narrowly cuneate, 4–5 mm long, densely ferruginous-hirsute; the hairs becoming crisped, shorter and white towards apex; exserted apex obtuse, striate, glabrous, upturned, green. *Floral bracts* similar but shorter and narrower, the apex more rounded, not upturned. *Flowers* in bud bright green, becoming yellow-gold at anthesis; style cream at base, metallic, shining red above, pollen-presenter cream. *Perianth* 17–18 mm long including limb of 3–3·5 mm; claws gently down-curved; limb erect at first, sharply downturned before anthesis and remaining thus; claws filiform, 0·3 mm wide near base narrowing to 0·1 mm wide, appressed-pubescent outside, glabrous inside about ovary, densely pubescent above with straight hairs, then almost glabrous except the margins, sparsely pubescent in upper part; limb narrowly fusiform, obtuse, appressed-pubescent outside, glabrous inside. *Anthers* 3 mm long, shortly apiculate, on filaments ± 2 mm long. *Pistil* 29–35 mm long unstraightened, ± 33–39 mm when straightened, ± straight in lower half, strongly recurved below apex through ± 180°, glabrous; pollen-presenter slightly thickened, ovoid, ± 0·3 mm long, brown; stigmatic groove oblique; ovary ± 1 m long, glabrous except for a few hairs at apex. *Hypogynous scales* narrowly triangular, obtuse, entire, 1 mm long. *Infructescence* cylindrical, 3·5–4 cm wide including follicles; the styles and perianths persistent for many years. *Follicles* up to 60, sometimes more, 10–18 mm long, 4–7 mm high, 3–7 mm wide; valves depressed semi-circular with a transverse shoulder or ridge, densely hirsute, the exposed parts becoming glabrous; ridge obtuse; suture fine; follicles opening 5–8 mm; lip 1·5–2·5 mm wide, broadest at the sides,

Seed 12–13 mm long; seed body narrowly triangular, 5–6 mm long, 3 mm wide, base obtuse, lateral margins somewhat convex, upper margin oblique without a ridge; inner face black, ± glistening, outer dark brown with paler mottling; wing 7–8 mm wide, upper margin flattened, grey-brown, glistening on both sides. *Separator* similar to seed in shape, ± 9 mm wide, dark brown.

Distribution. (Fig. 79) South West Western Australia: an interrupted distribution along the south coast from Augusta to Cape Arid, always within 30 km of the coast.

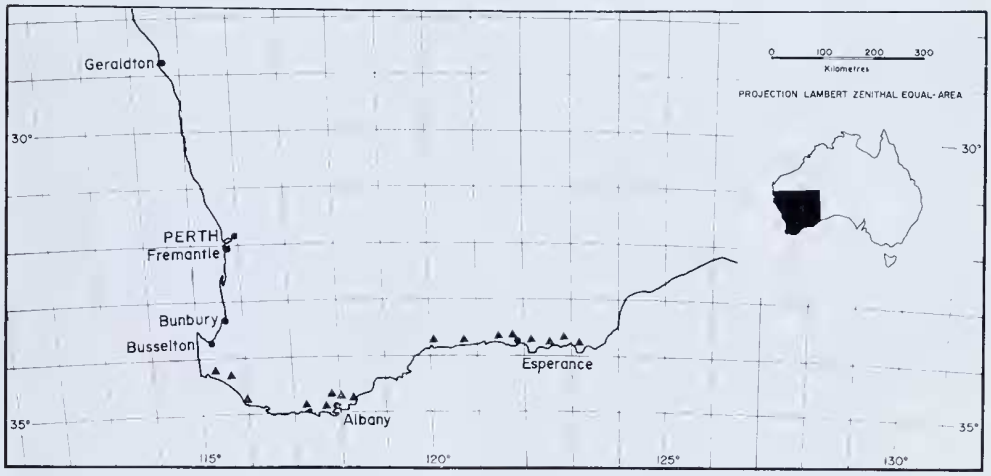


Figure 79. Distribution of *Banksia occidentalis*.

Selected collections. W end of Scott River plains, 3 Feb. 1976, *A. S. George* 14232 (PERTH); Black Point near Cape Beaufort, Feb. 1978, *P. Luff* (PERTH); Wilsons Inlet, 22 Dec. 1877, *F. Mueller* (MEL); District South West Plantagenet, Jan. 1901, *E. Pritzel* 217 (BP, MEL, NBV, NSE, S, Z); Cheyne Beach, 27 May 1959, *G. M. Storr* s.n. (PERTH); 7 miles (11 km) N of Esperance, 2 Nov. 1968, *J. W. Wrigley* s.n. (CBG, NSW); 45 km E of Esperance, 14 Nov. 1974, *D. J. Whibley* 5452 (AD, PERTH); Cape Arid National Park, 29 Nov. 1971, *R. D. Royce* 9885 (PERTH).

Habitat. In sand or peaty sand, usually in low-lying areas such as swamp margins, in tall shrubland, or in low open woodland with the paperbark *Melaleuca preissiana;* occasionally in low heath in seepages on the coast; E of Esperance often on consolidated sand dunes in tall shrubland.

Flowering period. Mainly December to March, but flowers have been recorded in all months except July to September.

Banksia occidentalis may be recognised by its whorled, narrowly linear leaves; narrow, closely pubescent perianths; slender red styles; and narrow follicles. The plants usually produce many inflorescences over several months with a peak in January-February. Developing buds are green, becoming pale gold at anthesis, but this colour is inconspicuous when the brilliant red styles are released. Seed production is fairly prolific, though many inflorescences set none at all.

The species is morphologically uniform except for a coastal population towards the western end of its range. Here the plants are only a metre tall and have broadly linear leaves 3–5 mm long and 4–6 mm wide. Frequent onshore winds probably cause this variation; progeny have not yet been grown to ascertain if it persists away from the coast, as happens with similar variants of *B. grandis* and *B. media*.

Banksia occidentalis is clearly related to the eastern species *B. spinulosa* Smith, especially its var. *cunninghamii* (Sieber ex Reichb.) A. S. George. The latter differs in a number of respects such as scattered broadly linear leaves, hirsute branchlets, larger flowers and broader fruits. It also occupies a different habitat, in sandy loam or on sandstone in forest. The link between the two, however, is stronger than that between any species of the *Orthostylis*, the only other series represented in both South Western and Eastern Australia.

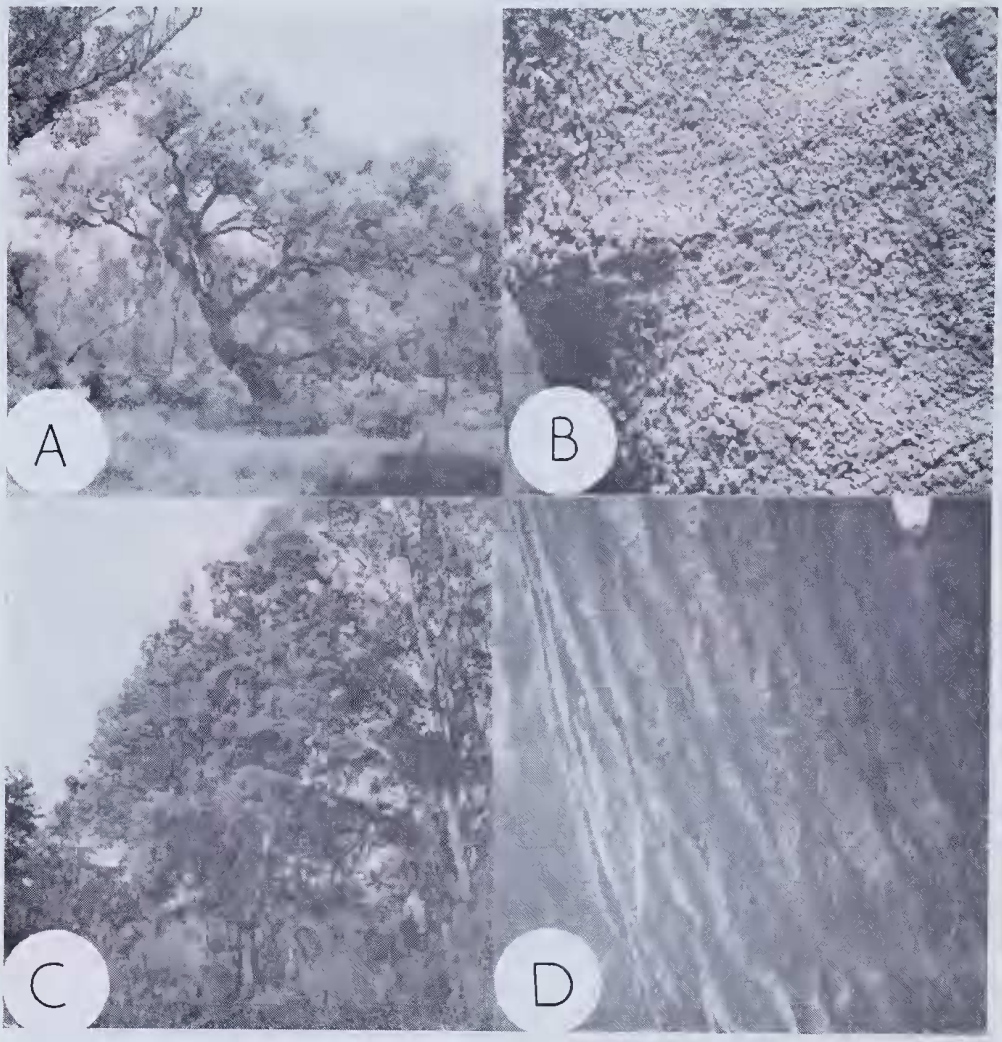


Figure 80. A and B—*Banksia littoralis* var. *littoralis*. A—Habit, 12 m tall. B—Bark. (Both Mandogalup, W.A.). C and D—*B. littoralis* var. *seminuda*. C—Habit, ± 16 m tall, and D—Bark (Both Tone R., W.A.).

53. Banksia littoralis R.Br. (Figure 80)

Trans. Linn. Soc. London 10:204 (Feb. 1810)—*Sirmuellera littoralis* (*littoralis*) (R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: ad littora arenosa sinuum. (ubi v.v. flor. delaps.)" Lecto (here chosen): BM, a sheet labelled by Brown "8 Banksia littoralis prodr. 392 King George's Sound Shores, especially of Princess Royal Harbour. Decr. 1801". Iso: BM, K, NSW.

Cotyledons (Fig. 9.48) obovate, sometimes slightly emarginate, 7–11 mm long, 4–5 mm wide, widely spreading, ± flat, bright green; auricles spreading, acute, 1·5 mm long. *Hypocotyl* slender, 1–2 cm long, glabrous or loosely hirsute, pale green to pinkish. *Seedling leaves* all opposite or upper leaves whorled; first two, 5–13 mm above cotyledons, oblong-elliptic, obtuse or acute, sessile, 8–16 mm long, 3–5 mm wide; margins ± flat, dentate on each side with 3–4 acute teeth ± 1 mm long; upper surface sparsely hirsute, becoming glabrous; lower surface closely white-woolly; higher leaves at nodes to 28 mm apart, oblong, elliptic or narrowly obovate, truncate, mucronate, sessile, 2–10 cm long, 7–18 mm diam.; margins flat or slightly recurved, acutely serrate with forward-pointing mucros; indumentum as in first leaves; midrib below hirsute becoming glabrous. *Seedling stem* sparsely hirsute above cotyledons, more densely so higher up, often becoming glabrous.

Mature plant a tree to 25 m, rarely a low shrub, fire-tolerant (var. *littoralis*) or fire-sensitive (var. *seminuda*); trunk to 1 m diam., leaning or erect; crown widely branched or erect. *Bark* 1–2 cm thick, finely verrucose and friable, or fissured and hard, grey. *Branchlets* densely tomentose-pubescent, pale brown, the indumentum persistent for 3–4 years. *Leaves* whorled or scattered, linear to broadly linear, obtuse or truncate, shortly mucronate, 7–23 cm long, 4–18 mm wide; margins recurved to loosely revolute, sometimes almost flat, usually serrate in upper half, sometimes almost to base, rarely quite entire; teeth acute or obtuse, distal side 0·5–2 mm long; sinuses U-shaped to very broad; upper surface appressed-pubescent becoming glabrous; lower surface on midrib pubescent and hirsute becoming glabrous, the lamina closely white-woolly; lateral nerves obscure; petiole 5–10 mm long, pubescent. *Inflorescence* terminal to 1–4 year old branchlet, usually with a whorl of lateral branchlets below, cylindrical, 6–7 cm wide at anthesis. *Axis* 7–20 cm long, 2–5 mm wide, 10–15 mm with common bracts, without flowers for ± 1 cm from base. *Involucral bracts* subulate-terete on thick bases, mostly 5–12 mm long, outer ones shorter, densely pubescent to tomentose, pale ferruginous, mostly persistent until flowering. *Common bracts* narrowly cuneate, 3–5 mm long, densely hirsute; exserted apex ± triangular, upturned to almost uncinate, obtuse, shortly tomentose, pale green-grey to almost white. *Floral bracts* similar but narrower, the exserted apex small, straight. *Flowers* yellow to pale gold; styles cream in lower half, yellow, sometimes deep red in var. *seminuda*, in upper half. *Perianth* 20–27 mm long including limb of 2·5–3 mm, straight except limb which is sharply turned upwards or downwards; claws ± 0·5 mm wide, tapering upwards, appressed-pubescent outside with the lowest hairs often retrorse, inside densely tomentose above glabrous base, pubescent above with ± glabrous midrib; claws involute after anthesis; limb elliptic to fusiform, almost acute, appressed-pubescent (in var. *littoralis*) or glabrous except sometimes at base (in var. *seminuda*), when glabrous the midrib prominent. *Anthers* ± 1 mm long on filaments of 0·75 mm shortly apiculate. *Pistil* 29–38 mm long, curved gently down then up, with the apical 5–10 mm curved through 80°–150°, glabrous; pollen-presenter narrowly ovoid, 0·4–0·5 mm long, obtuse, smooth or slightly wrinkled when dry; stigmatic groove small, oblique; ovary glabrous except for a few short ferruginous hairs about apex. *Hypogynous scales* linear-oblong, obtuse, ± 1 mm long. *Infructescence* moderately stout; old flowers early deciduous; common and floral bracts enlarged, indurated, grey. *Follicles* up to ± 200, usually well-spaced but sometimes crowded and appearing more so when open, in plan view broadly linear to narrowly elliptic, 11–22 mm long, 2·5–8 mm high, 4–8 mm wide; valves semi-elliptic, often transversely ridged above base, otherwise smooth, closely tomentose, exposed parts becoming glabrous; dark grey; ridge ± acute; suture very fine; follicles

usually opening spontaneously within 1–2 years, when open up to 14 mm across, valves recurved; lips 1·5–3 mm wide. *Seed* obovate, 15–18 mm long; seed body ± triangular, 5–8 mm long, 4–5 mm wide, obtuse at base; lateral margins gently convex, not winged; upper margin usually oblique; inner face ± convex, slightly rugose to smooth, black; outer face gently convex, rugose, dark brown; wing 8–13 mm wide, slightly expanded on anti-stylar side, the upper margin ± oblique, dark brown. *Separator* similar to seed in size and shape, slender, impressed against seed body not beaked; wings recurved.

Banksia littoralis contains two well-defined varieties which differ in habit, bark, leaves and indumentum of the perianth.

53A. Banksia littoralis R.Br. var. **littoralis** (Figure 80A and B)

A tree to 12 m, rarely a shrub, fire-tolerant; trunk usually irregular; bark verrucose, ± friable. *Leaves* linear, 10–23 mm long, up to 10 mm wide; margins recurved, usually serrate only towards apices. *Perianth* pubescent throughout, the limb usually upturned before anthesis. *Pistil* usually 29–35 mm long, recurved up to 90° below apex.

Distribution. (Fig. 82) South West Western Australia: from Mt. Lesueur southwards within 80 km of the coast, and eastwards to Two Peoples Bay and the Stirling Range.

Selected collections. 1 km SE of Mt. Lesueur, NE of Jurien, 5 Dec. 1979, *E. A. Griffin* 2656 (PERTH, CANB); Hill R., W of Badgingarra, 25 April 1961, *A. S. George* s.n. (PERTH); Helena R., Mundaring Weir, 25 June 1925, *C. A. Gardner* s.n. (PERTH); 31 miles (50 km) S of Mandurah, 16 May 1964, *A. S. George* 6210 (PERTH); Fisherman road, Broke Inlet, Jan. 1980, *T. G. Wilson* (PERTH); Near junction of Chester Pass road and Stirling Range Drive, Stirling Range, 21 May 1972, *A. M. Ashby* 4483 (PERTH); Near Moses Rock, S of Yallingup, 4 Feb. 1976, *A. S. George* 14235 (PERTH).

Habitat. In low-lying, seasonally damp areas, in sand or peaty sand, usually forming low open-woodland, often associated with *Melaleuca preissiana*; south of Mandurah an understorey tree of Tuart (*Eucalyptus gomphocephala*) forest; occasionally in coastal heath as a low shrub.

Flowering period. March to July; a few flowers sometimes seen as early as February or as late as October.

This is the common Swamp Banksia of the coastal plain from the Moore River to Albany. Outlying populations occur northwards to Mt. Lesueur, on the Darling Plateau through the Jarrah forest, and in the Stirling Range. The trees are typically of irregular habit with a bushy crown which in windy conditions assumes a silvery aspect derived from the exposed white undersurface of the leaves. They are not killed by fire but sprout from epicormic shoots.

53B. Banksia littoralis R.Br. var. **seminuda** A. S. George, var. nov. (Figures 80C and D, 81)

Arbor ad 25 m alta, ab igne interfecta; truncus plerumque rectus; cortex fissuratus, durus. *Folia* late linearia, (3)5–12 cm longa, ad 18 mm lata, saepe serrata, marginibus parum vel multo recurvis. *Perianthium* limbo glabro plerumque ante anthesin deorsum curvato. *Pistillum* plerumque 32–38 mm longum, infra apicem ad 150° recurvum.

Type: Nanga Brook, S of Dwellingup, Western Australia, in 32°49′S lat., 116°04′E long., 15 May 1973, *A. S. George* 11655. Holo: PERTH; iso: CANB, K, MEL, NSW, PERTH (fruit).

Derivation of name. From the Latin *semi*, half, and *nudus*, bare, in reference to the glabrous perianth limb.

A tree to 25 m, fire-sensitive; trunk usually straight; bark fissured, hard. *Leaves* broadly linear, (3)5–12 cm long, up to 18 mm wide, often serrate for most of length; margins recurved, usually slightly. *Perianth* pubescent with glabrous limb, usually turned down before anthesis. *Pistil* mostly 32–38 mm long, recurved up to 150° below apex.

Distribution. (Fig. 82) South West Western Australia: on the Darling Plateau from Banksiadale southwards, and near the south coast from Broke Inlet to Two Peoples Bay.

Figure 81. *Banksia littoralis* var. *seminuda*. Holotype, A. S. George 11655 (PERTH).

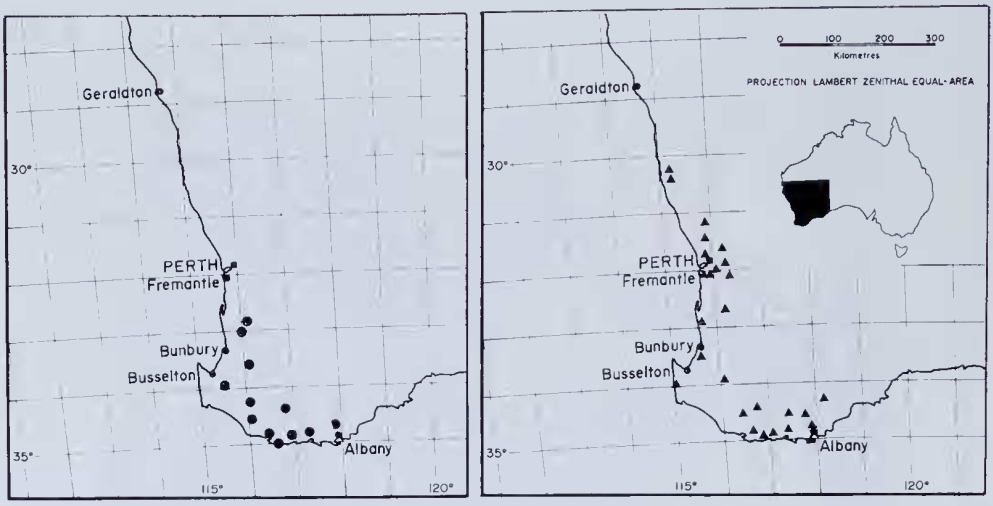


Figure 82. Distribution of *Banksia littoralis* var. *littoralis* (▲) and *B. littoralis* var. *seminuda* (●).

Selected collections. Upstream of Baden Powell waterspout on Murray R., 30 April 1978, *S. D. Hopper* s.n. (PERTH); Big Brook, no date, *M. Koch* 2756 (BRI, MEL); Camfield, Broke Inlet, 10 May 1974, *A. S. George* 11789 (PERTH); Crystal Springs, Long Point, 20 August 1973, *G. Liddelow* 778 (PERTH); Napier Ck., 15 miles (24 km) N of Albany, Nov. 1909, *J. H. Maiden* s.n. (NSW); Walpole, June 1974, *G. Rogerson*— fls. red (PERTH).

Habitat. Usually in red loam or gravelly loam along creek and river banks in Jarrah forest or on lower hill slopes; also recorded on low-lying sandy flats, and on coastal sand dunes.

Flowering period. April to July.

The var. *seminuda* is readily distinguished from var. *littoralis* by the characters given in the diagnosis, of which the most prominent are the broader leaves and the glabrous perianth limb. In typical forest habitats along creeks, the habit is also characteristic, being straight-trunked and very tall; examples have been recorded to 25 m, the tallest trees in the genus (Powell, 1978). In more exposed habitats such as at Broke Inlet (George 11789) and Coalmine Beach, Nornalup (Royce 8417), the habit is lower and of irregular form, similar to that of var. *littoralis*.

Less obvious differences between the varieties are the thinner leaves of var. *seminuda* and the slightly deeper colour of the flowers derived from the glabrous limb. Red-styled forms are known only in var. *seminuda* but have been recorded at several localities, always mixed with yellow-flowered trees.

The different orientation of the perianth limb is noteworthy, but I am uncertain if it is consistent, as with fully open flowers it is difficult to ascertain the orientation before anthesis. In both varieties the style is exserted along the lower side of the perianth, so that with the upturned limb of var. *littoralis* the style-end has to bend through about 90° to where the pollen-presenter is inserted; with the downturned limb of var. *seminuda* it curves through almost 270°. After anthesis the latter form relaxes to retain a curve of 90°–150°. The significance of this is unknown but it is probably related to different pollinators.

The two varieties grow together at several localities but no intermediate forms have been seen.

The closest relative of *B. littoralis* is *B. occidentalis* R.Br. The latter is always a shrub, fire-sensitive, with thin ± smooth bark, narrower leaves, smaller flowers with finer styles (always red) and smaller follicles; the old perianths persist for some years on the infructescence.

Figure 83. *Banksia verticillata*. A—Habit, 3 m tall. B—Bark. (Both Torndirrup National Park, W.A).

54. Banksia verticillata R.Br. (Figure 83)

Trans. Linn. Soc. London 10: 207 (Feb. 1810)—*Sirmuellera verticillata* (R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi: Lewins Land: prope littora, (ubi v.v.)". Lecto (here chosen): BM, annotated by Brown "Banksia verticillata King George IIId Sd. arbor biorgyalis usque 18 pds" and "16., Banksia verticillata prodr. 394. King George's Sound Decr. 1801." Iso: BM (fruit), K, NSW (130680, 131353).

Cotyledons (Fig. 9.49) obovate, widely spreading, ± 12 mm long, 7 mm wide, flat, deep green, 3-nerved and faintly reticulate; auricles ± horizontal, obtuse, 1·5 mm long. *Hypocotyl* moderately stout, glabrous, dull red. *Seedling leaves* in opposite pairs, the higher ones verticillate; first two ± 5 mm above cotyledons, oblong, obtuse, sessile, shortly and obtusely dentate in distil half, margins ± flat; next pairs 10–15 mm part, oblong, obtuse, 20–35 mm long, 5–10 mm wide, margins flat, obtusely dentate in distal half, the teeth ± 1 mm long; in all leaves the upper surface hirsute becoming glabrous; lower surface closely white-woolly; nerves obscure. *Seedling stem* sparsely hirsute at base, more densely so above. Leaves of older seedlings similar but often narrowly elliptic, rounded or truncate, up to 7 cm long, 18 mm wide, shortly petiolate; stem closely pubescent with curled hairs and loosely hirsute with straight hairs; entire leaves developing after 2–3 years.

Mature plant a shrub (rarely tree) to 5 m with a thick trunk, much-branched above. *Bark* ± 1 cm thick, hard, roughly fissured, grey. *Branchlets* irregularly ribbed when dry, closely pubescent when young with short curled hairs and sparsely hirsute with long hairs, becoming glabrous; a few subulate-terete tomentose brown bracts on lower part, deciduous. *Leaves* whorled, sometimes scattered, the internodes 1–2 cm long; leaves narrowly elliptic to oblong, obtuse, 3–9 cm long, 7–12 mm wide, narrowed to a petiole 5–11 mm long; margins entire, recurved; upper surface when young loosely hirsute becoming glabrous but finely granular, midrib slightly impressed, lateral nerves evident when dry; lower surface densely tomentose with matted, crisped, white hairs, midrib hirsute with long ferruginous hairs becoming glabrous; leaves drying yellow-green. *Inflorescence* terminal to a usually 1 year old branchlet, with several lateral branches immediately below. *Involucral bracts* subulate from broad bases, up to 15 mm long, densely ferruginous-hirsute, persistent. *Axis* 8–20 cm long, 4–5 mm wide, 11–13 mm wide with common bracts; no flowers for 9–17 mm from base and at extreme apex. *Common bracts* narrowly cuneate, 3–4 mm long, densely ferruginous-hirsute; exserted apex thickened to 2·5–3 mm wide, shortly tomentose with curled hairs, apex upturned and somewhat raised. *Floral bracts* similar but smaller. *Flowers* golden yellow throughout; styles pale yellow. *Perianth* 25–30 mm long including limb of 3·5–4 mm, straight but with limb upturned before

anthesis; claws 0·5 mm wide above base, tapering upwards, closely pubescent outside, glabrous inside above base but pubescent along upper margins which are involute after anthesis; limb narrowly ovate to oblong, obtuse, thick, densely pubescent with pale-ferruginous straight hairs. *Anthers* elliptic, 1 mm long; filaments short and thick; connective broad, shortly and obtusely produced. *Hypogynous scales* broadly oblong, obtuse or bilobed, sometimes cohering. *Pistil* 30–35 mm long, ± straight but curved through 60°–90° below apex; thick, tapering upwards, slightly constricted and ribbed below pollen-presenter, glabrous except sometimes a row of short hairs extending a few mm above ovary; pollen-presenter ovoid, obtuse, 0·4–0·5 mm long; stigmatic groove small, terminal; ovary ± 1 mm long, the apex pubescent with straight ferruginous hairs. *Infructescence* ± oblong, perianths somewhat persistent but finally deciduous; axis 4·5–5 cm diam. including bracts. *Follicles* in plan view narrowly elliptic, 11–15 mm long, 2–3 mm high, 3–4 mm wide; valves semi-circular, ± smooth, tomentose with short, spreading hairs; ridge ± acute; suture fine; opening without fire after several years, the valves recurving; lips ± 2 mm wide, dark brown. *Seed* obovate-cuneate, 18–20 mm long; seed body narrowly cuneate, 10–11 mm long, acute to obtuse at base, upper margin oblique; outer surface smooth, grey-brown, inner slightly rugose; wing 8–10 mm wide, apex rounded, slightly oblique, dark brown. *Separator* similar to seed in shape and size, dark brown tending to almost black at apex.

Distribution. (Fig. 84) South West Western Australia: in two disjunct areas close to the south coast, one near Walpole and one from Albany to Two Peoples Bay; the most inland locality is about 10 km from the coast.

Selected collections. Swan River (Colony), no date, *J. Drummond* 304 (BM, K, MEL, OXF); Woolbale Rock, NW of Walpole, 6 Jan. 1980, *T. G. Wilson* (CANB, MEL, NSW, PERTH); Near Frenchmans Bay, Albany, Dec. 1937, *W. E. Blackall* s.n. (PERTH); Mermaid Point, E of Albany, 7 March 1979, *B. Wells* (PERTH.)

Habitat. On or beside granite outcrops, usually very exposed; occasionally in tall shrubland.

Flowering period. January to April.

Banksia verticillata is a species of restricted distribution confined to small populations except for one locality near Walpole where it was described as "common". It is the only species of *Banksia* in South Western Australia to be restricted to granitic soil. I have not seen its response to fire and therefore do not know if it is tolerant or sensitive. Because it is usually on granite outcrops it is probably burned very infrequently.

The species is clearly related to *B. littoralis* R.Br., differing from that species as follows: spreading, bushy habit; shorter, entire, coriaceous adult leaves; longer, more hirsute involucral bracts; brown common and floral bracts; perianth claws glabrous inside above ovary; limb more densely pubescent; infructescence thicker with the follicles less exserted. The habitats are also different, and *B. verticillata* begins to flower 1 to 2 months before *B. littoralis*. Although the development of the inflorescence is basipetal in *B. verticillata*, at anthesis the flowers often open in an irregular order.

Two sheets at PERTH collected in 1917 by F. M. C. Schock are labelled "Mt. Hoskin" and "Mt. Hosking, Frankland River". I have been unable to trace this locality which may be an error for Mt. Hopkins just west of Walpole where the species occurs.

55. Banksia tricuspis Meissner

Hook. Journ. Bot. & Kew Gard. Misc. 7: 118 (1855)—*Sirmuellera tricuspis* (Meissner) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "Drummond, coll. vi. n. 205." Lecto (here chosen): NY; iso: B, BM (2 sheets), CGE, FI, K (3 sheets), LD, MEL (4 sheets), P, PERTH.

Cotyledons (Fig. 9.50) broadly obovate, spreading, 15–18 mm long, 15 mm wide, bright green, margins red, very faintly reticulate; auricles spreading, obtuse, 1·5 mm long. *Hypocotyl* stout, glabrous. *Seedling leaves* opposite for 3–4 pairs, then ± scattered but higher leaves verticillate; first 2–4 broadly linear, obtuse, 16–25 mm long, 4–4·5 mm

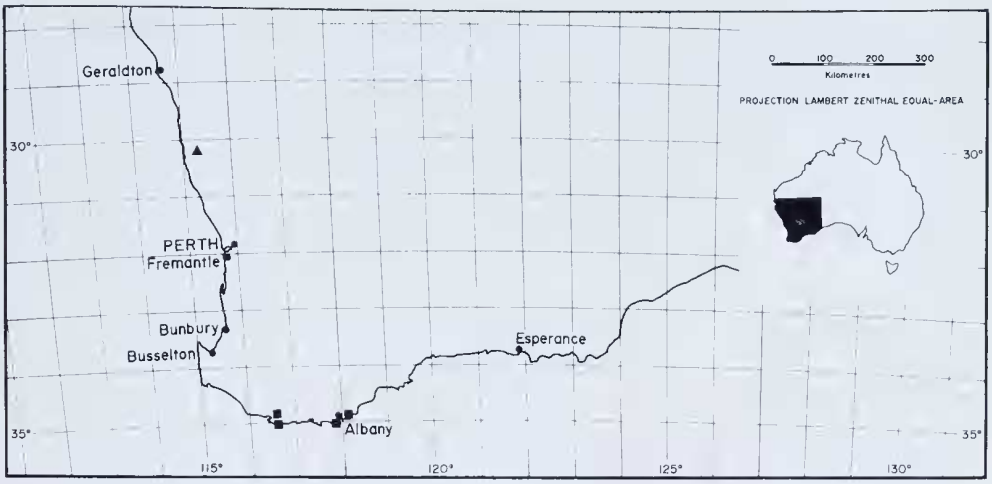


Figure 84. Distribution of *Banksia verticillata* (■) and *B. tricuspis* (▲).

wide; margins recurved, entire; upper surface loosely hirsute with white hairs; lower surface hirsute on midrib, the lamina sparsely woolly; higher leaves becoming longer and narrower with more recurved margins, to 5 cm long, by about the 20th leaf 1·5 mm wide, the margins revolute. *Seedling stem* sparsely hirsute with spreading white hairs; orange-brown.

Mature plant a shrub or stunted tree to 4 m. *Trunk* stout; bark finely tessellated or rugose, ± hard, grey; crown rather open, irregular. *Branchlets* finely ribbed when dry, densely leafy but leaves persisting for only 1–2 years; lowest 0·5–1 cm of branchlet with deciduous, subulate, closely tomentose prophylls, less than 1 cm long. *Leaves* crowded, scattered, narrowly linear, obtusely mucronate, 5–13 cm long, 1–1·5 mm wide; margins tightly revolute and touching midrib, entire except for a single obtusely mucronate small lobe on each side next to the apex; upper surface hirsute becoming glabrous; lower surface white-woolly, concealed by revolute margins; midrib below hirsute, becoming glabrous, impressed but flat; petiole 2–5 mm long, closely tomentose becoming glabrous. *Inflorescence* cylindrical, 7–9 cm diam. at anthesis on short lateral branchlet or terminal, the branchlet usually leafy immediately below. *Axis* 7–15 cm long, 4–5 mm wide, 11–12 mm wide with common bracts, without flowers for up to 1 cm at base. *Involucral bracts* subulate-terete on very swollen bases, keeled, 2–5 mm long, shortly tomentose with curled hairs, the sides of the bases hirsute, some deciduous by anthesis, pale brownish-grey. *Common bracts* narrowly cuneate, 3–3·5 mm long, densely hirsute, deep ferruginous; exserted apex ± triangular but strongly upturned and incurved, obtuse, shortly tomentose, pale brown, midrib slightly raised. *Floral bracts* shorter, narrower, with small obtuse exserted apex. *Flowers* golden with bright yellow styles; perianth drying dark reddish brown. *Perianth* 23–26 mm long including limb of 2·5 mm; limb turned sharply downwards before anthesis; claws ± 0·4 mm wide, tapering upwards, cohering for most of their length after anthesis, glabrous outside at base, shortly appressed-pubescent above, glabrous inside but below limb almost rugose; limb elliptic, thick, obtuse, appressed-pubescent. *Anthers* 3 mm long on short thick filaments, shortly apiculate. *Hypogynous scales* narrowly to broadly oblong, ± 1 mm long, obtuse or emarginate, often alternately broad and narrow. *Pistil* 32–37 mm long, gently curved, the upper 4–5 mm strongly turned downwards into the limb, after anthesis the apex recurved through 150°–180°; glabrous; pollen-presenter ovoid but compressed, obtuse, 1 mm long, dark with pale apex; stigmatic groove lateral below apex on lower side; ovary glabrous. *Infructescence* moderately stout, 6–8 cm diam., the common and floral bracts enlarged; involucral bracts, old perianths and styles early deciduous. *Follicles* up to 35, prominently exserted, in plan view elliptic, 15–28 mm long, 8–16 mm high, 8–14 mm wide; valves ± semi-circular,

often shortly and obtusely beaked at stylar point, convex, slightly rugose, glabrous, grey; follicles opening with fire, up to 18 mm wide, the valves recurved, shortly split from stylar point leaving obtuse beak; lips 1–1·5 mm wide, widening to 2–3 mm at base of antistylar side. *Seed* obovate, 23–28 mm long; seed body ± obovate with upper margin oblique, 11–17 mm long, 9–12 mm wide; lateral margins straight to convex, not winged; base obtuse; inner face convex, somewhat rugose, black, glistening; outer face ± flat, rugose, dark brown, dull; wing 13–20 mm wide, thin, brown. *Separator* similar to seed in shape and size, robust, concave and slightly rugose against seed body, thickened and sometimes overhanging above, not beaked at stylar point; wings recurved in upper third.

Distribution. (Fig. 84) South West Western Australia: restricted to small area around Mt. Lesueur, north-east of Jurien.

Selected collections. Summit of Mt. Lesueur, 10 June 1931, *C. A. Gardner* s.n. (PERTH); 15 km W of Brand Hwy. near Mt. Lesueur, 2 June 1978, *T. Griffin* 1028 (PERTH).

Habitat. In lateritic, rocky soil, sometimes at breakaway edges, in tall open shrubland with open-heath understorey.

Flowering period. Late March to July.

Banksia tricuspis is a clearly distinct species of very restricted distribution. Its characteristics are the stunted arborescent habit; linear leaves with tridentate apices, crowded on the upper branchlets; the conspicuous golden inflorescence; the perianth which is glabrous inside; the robust infructescence with prominent glabrous follicles that remain closed until burnt, with deciduous old flowers. The species is rather isolated from other members of the series *Spicigerae* but probably is related to *B. littoralis* R.Br. and *B. verticillata* R.Br., though having narrow leaves with revolute margins like *B. spinulosa* var. *spinulosa*.

Series **Dryandroideae** Meissner

in DC., Prodr. 14: 464 (1856).

Shrubs without lignotubers. *Branches* ± spreading. *Leaves* scattered, broadly linear, pinnatipartite, the lobes numerous, linear-triangular, margins revolute. *Inflorescence* squat. *Follicles* narrowly elliptic.

Type species: **Banksia dryandroides** Baxter ex Sweet, lecto. nov.

The series as here defined contains only one species, *B. dryandroides*. As originally circumscribed by Meissner, on the basis of leaves alone, it encompassed such diverse species as *B. grandis*, *B. baxteri*, *B. victoriae*, *B. elegans*, *B. candolleana* and *B. brownii*. Bentham (1870), who did not take up the *Dryandroideae*, placed *B. brownii* and *B. dryandroides* in the series *Abietinae* on the basis of the hooked style. The affinity of these two species is certainly with the section *Oncostylis* in which that series falls, but on the basis of floral, fruit and seed characters as well as foliage I consider *B. brownii* to belong to the series *Spicigerae*. *Banksia dryandroides* appears to provide a link between the *Spicigerae* and the *Abietinae* but is sufficiently distinct from both to be placed in its own series.

56. Banksia dryandroides Baxter ex Sweet

Fl. Australas. 56 (1828)—*Sirmuellera dryandroides* (Baxter ex Sweet) Kuntze, Rev. Gen. Pl. 2: 582 (1891)—as "*dryandrodes* (Baxt.) OK."

Type citation: none. The species was described from a plant raised from seed collected by William Baxter on the south coast of New Holland. At K and BM there are several sheets collected by Baxter and from these a neotype is here nominated. It is one of two collections on a sheet at BM, labelled "Banksia new Seeds marked Dryandroides".

Cotyledons (Fig. 9.44) obovate but broad at base, curved, 9–10 mm long, 5 mm wide, ascending, convex, deep bright green, reticulate; auricles descending, acute, 2–3 mm long. *Hypocotyl* slender, 14–17 mm long, glabrous, green. *Seedling leaves:* first 2 opposite,

5–8 mm above cotyledons, ± oblong, sessile, acute, 13–18 mm long, 4–5 mm wide; margins slightly recurved, deeply serrate with 3–5 teeth each side, the teeth acute, triangular, turned upwards; lamina shortly hirsute above, densely white-tomentose below with also a few long hairs on midrib; upper leaves scattered, up to 10 cm long, 14 mm wide, the lobes numerous, divided almost to midrib, acute. *Seedling stem* closely woolly, white.

Mature plant an intricately branched spreading shrub without lignotuber, to 1 m tall, 1·5 m wide. *Branchlets* densely tomentose with curled hairs and hirsute with long hairs, ferruginous becoming grey-white and wearing off after 2–3 years, the bark then ± smooth with small round lenticels, reddish brown; basal part without or with few linear, villous prophylls. *Leaves* scattered, broadly linear, often flexuose, 5–17 cm long, 7–15 mm wide, truncate with an obtuse, villous, deciduous mucro; deeply divided, usually almost to midrib, into many triangular, acute lobes 2–6 mm wide at base, not imbricate, often slightly upturned; margins strongly revolute; lamina rather loosely hirsute above, becoming glabrous but minutely scabrous; densely tomentose below on the midrib with curled hairs and hirsute with long spreading hairs, the lobes densely white-woolly, all hairs ± persistent; lateral venation obscured; leaves sessile or with very short, thick, tomentose petiole; leaves when young bright green above with red apices to the lobes. *Inflorescences* very small, on short lateral leafy branchlets from older stems, 3–3·5 cm diam. at anthesis, hidden within plant. *Axis* 2–3 cm long, + 3 mm wide, 10–11 mm wide with common bracts, bearing flowers throughout. *Involucral bracts* few, the outer ones linear-clavate, 5–6 mm long, villous, brown with dark brown apices; inner ones filiform on thick bases, 5–7 mm long, tomentose-hirsute, pale brown. *Common bracts* narrowly cuneate, 3–3·5 mm long, densely hirsute with pale ferruginous hairs; exserted apex very small, conical, upturned, obtuse, ferruginous-tomentose around edges, almost glabrous dorsally where bright green, extreme apex ± penicillate. *Floral bracts* similar but narrower with smaller apices. *Flowers* pale brown or dull orange throughout; indumentum pale; styles cream. *Perianth* 15–16 mm long including limb of 1·5–2 mm, straight with limb sharply upturned before anthesis; claws filiform, ± 0·3 mm wide at base with margins above base ± crenulate, densely tomentose or almost hirsute outside, glabrous inside except a few hairs along upper margins; limb fusiform but broadest above middle, almost acute, hirsute. *Anthers* 0·75 mm long on filaments of 0·5 mm, shortly apiculate. *Hypogynous scales* narrowly linear, acute, 2·5 mm long, free. *Pistil* 14–15 mm long, straight but with the apex upturned through 90°–100°, glabrous; pollen-presenter ± turbinate, 0·5 mm long, apex cushion-like with lateral stigmatic groove, slightly expanded to one side where the stigmatic groove lies, with a somewhat thickened red-brown collar below that is vertically channelled from the stigmatic groove; ovary glabrous. *Infructescence* spherical, often depressed, 4–6 cm diam.; old perianths and styles long-persistent; some involucral bracts persistent. *Follicles* prominent, up to 25, in plan view linear to narrowly elliptic, undulate, 15–30 mm long, 5–12 mm high, 3–9 mm thick; valves broadly semi-elliptic, flat to slightly convex, smoothly rugose, more coarsely so upwards, densely ferruginous-hirsute in lower half, glabrous and shining above; suture prominent, impressed; follicles usually opening with fire; valves recurved, not beaked; lips 1 mm wide, ± even. *Seeds* broadly obovate, 20-28 mm long; seed body narrowly obovate-falcate, 9-10 mm long, 3 mm wide, obtuse at base, apex narrowly produced towards stylar point, winged to base on both sides; inner face convex, very slightly rugose, black, somewhat glistening; outer face flat to undulate, smooth, dark brown, somewhat shining; wing 17-26 mm wide, slightly expanded on stylar side, black-brown inside, dark brown outside. *Separator* similar to seed in shape and size, obtuse to acute at base, impressed against seed body, somewhat thickened above especially on stylar side; wings recurved.

Distribution. (Fig. 77) South West Western Australia: near the south coast from Narrikup to Beaufort Inlet.

Selected collections. E of Albany Hwy. near Narrikup, 26 May 1964, *A. S. George* 6222 (PERTH); Swan River Colony, *J. Drummond* s.n. (MEL, OXF, U); Cape Riche, 9 Oct. 1928, *C. A. Gardner* 2159 (PERTH); Near Pt. Irby, Beaufort Inlet, 29 March 1964, *A. S. George* 6153 (PERTH).

Habitat. In clay-loam and sandy loam sometimes over gravel, on low-lying flats, in tall open shrubland or low open-woodland; also, in the eastern part of its range, on low sandstone hills in heath.

Flowering period. October to January; the old flowers persist for some months even if unfertilised.

Banksia dryandroides has the shortest pistil of any species in the genus, though both *B. meisneri* and *B. pulchella* have smaller perianths. The inflorescences are usually inconspicuous, being borne well within a shrub which has rather intricate branches and leaves. They produce nectar and a mouse-like scent, and are probably pollinated mainly by small marsupials.

Series **Abietinae** Meissner

in DC., Prod. 14: 452 (1856).

Lectotype species (here chosen): **Banksia sphaerocarpa** R.Br.

Shrubs with or without lignotubers. *Stems* erect, ascending or spreading. *Leaves* linear, entire, with revolute margins. *Inflorescence* spherical to shortly cylindrical; development basipetal (acropetal in *B. nutans* R.Br.). *Follicles* small to large, mostly opening only with fire, when open without lateral beak. *Seed* obovate; seed body usually narrow; wing not notched.

The *Abietinae* contains the following 13 species, all endemic in South West Western Australia: *B. grossa* A. S. George, *B. incana* A. S. George, *B. lanata* A. S. George, *B. laricina* C. Gardner, *B. leptophylla* A. S. George, *B. meisneri* Lehm., *B. micrantha* A. S. George, *B. nutans* R.Br., *B. pulchella* R.Br., *B. scabrella* A. S. George, *B. sphaerocarpa* R.Br., *B. telmatiaea* A. S. George and *B. violacea* C. Gardner. As originally circumscribed by Meissner it also included *B. ericifolia* L.f., *B. spinulosa* Smith and *B. tricuspis* Meissner but these three species are here transferred to a new series, *Spicigerae*. The *Abietinae* is left as a fairly well-knit group characterised by linear leaves and short, rounded inflorescences and infructescences. Nine of the included species are very closely related; of these, only three species and one variety (here raised to specific rank) were described prior to this revision. This was due partly to a lack of good collections in flower and fruit, and partly to lack of field studies. The other four species—*B. laricina*, *B. meisneri*, *B. nutans* and *B. pulchella*—are less closely related but clearly belong with the series. *Banksia laricina* is distinguished especially by the remarkable attenuation of its follicles; *B. meisneri* and *B. pulchella* by the small flowers with very short perianths and by the small follicles; and *B. nutans* by its pendent inflorescences, crowded flowers, aeropetal development and large, ± flat-topped follicles.

The presence or absence of a lignotuber is constant within all species excepting *B. violacea* in which both states occur. In general, non-lignotuberous species are more vigorous and set more fruit than do lignotuberous ones. Among the latter the extreme seems to have been reached in southern populations of *B. sphaerocarpa* in which few fruit develop and those that do form contain very few viable seeds. These populations must be very stable, regenerating from the lignotubers after each fire. Species with lignotubers generally inhabit heavier lateritic soils.

Apart from some populations of *B. sphaerocarpa*, the *Abietinae* are all plants of heaths and shrublands. Most occur in the medium- to low-rainfall regions of South Western Australia in dry situations. Both *B. meisneri* (both subspecies) and *B. telmatiaea*, however, grow in low-lying swampy habitats. *Banksia sphaerocarpa*, the most widespread and variable species of the series, grows in shrublands, in the Jarrah forest and in Wandoo woodland. Both *B. leptophylla* and *B. violacea* also have extensive distributions. On the other hand *B. lanata*, *B. laricina*, *B. micrantha* and *B. scabrella* are restricted to small areas.

The greatest speciation of the *Abietinae* has occurred north of Perth, especially in the heaths from Gingin to Geraldton where nine species are found. Generally each occupies a distinct habitat, but occasionally two species occur together, e.g. *B. violacea* and *B. sphaerocarpa* var. *caesia*, *B. grossa* and *B. sphaerocarpa* var. *sphaerocarpa*, and *B. scabrella* and *B. leptophylla*.

57. Banksia sphaeroearpa R.Br. (Figures 85, 86 and 87A)

Trans. Linn. Soc. London 10: 203 (Feb. 1810)—*Sirmuellera sphaerocarpa* (R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land; in ericetis depressis. (ubi v.v.)". Lecto (here chosen): BM, annotated by Brown "Banksia affinis (m.s. name) A single plant observ'd between Princess Royal Harbour & Oyster Harbour on a heath", "King George IIId Sound South coast of New Holland Decr. 1801"; and later determined by Brown as "2 Banksia sphaerocarpa". There is a fruit in the carpological collection at BM.

Cotyledons (Figs. 9.51, 9.52) obovate, 11–12 mm long, 4·5–7 mm wide, recurved, faintly 3-nerved; auricles recurved, acute to obtuse, 1–2 mm long. *Hypocotyl* short, moderately stout, loosely hirsute. *Seedling leaves* somewhat crowded, the first two 5–10 mm above cotyledons, broadly linear, acute, entire, 8–14 mm long, hirsute (often sparsely) above and on midrib below, lower surface visible, white-woolly; margins recurved; higher leaves progressively longer and the margins becoming more closely revolute, otherwise similar. *Seedling stem* hirsute; lateral branchlets developing immediately above cotyledons in 6–12 months.

Mature plant a shrub to 4 m tall with many stems arising from a lignotuber, the plant often broader than tall. *Branchlets* pubescent when young with short curled and long straight hairs usually becoming glabrous, orange-brown, ± leafy throughout except for deciduous prophylls along the lower 1–2 cm, the leaves more crowded towards apices. *Leaves* linear, straight or slightly incurved, ± erect, 2·5–10 cm long, 1·5 (rarely 2) mm wide, pungent with a short mucro; margins closely revolute, entire; upper surface appressed -hirsute becoming glabrous; midrib slightly impressed, hirsute with ferruginous hairs becoming glabrous; lower surface closely woolly but concealed; petiole 2–3 mm long, pubescent with curled hairs becoming glabrous. *Inflorescence* on short lateral leafy branchlet, sometimes terminal, ± spherical, 7–10 cm wide. *Axis* 3–6 cm long, 8–10 mm wide, 20–27 mm wide with common bracts. *Involucral bracts* subulate from broad bases, up to 7 mm long, tomentose with curled ferruginous hairs except midrib and apex which are glabrous. *Common bracts* linear, 6–9 mm long, densely ferruginous-hirsute; exserted apex depressed-conical, tomentose, whitish, extreme apex slightly upturned. *Floral bracts* similar but smaller. *Flowers* golden brown to ferruginous, the styles golden-brown, often purple or deep red. *Perianth* 24–55 mm long including limb of 3–5 mm, ± straight but limb recurved; claws filiform, 0·2–0·3 mm wide, separating above tube, hirsute outside with ± straight hairs, densely pubescent inside above ovary, then appressed-hirsute but often glabrous in upper part and sometimes along midrib; limb fusiform, almost acute, densely hirsute outside with straight hairs, the centre sometimes becoming glabrous. *Anthers* ± 1·5 mm long. *Hypogynous scales* ± 2 mm long, acute to truncate, often irregularly lobed. *Pistil* 29–65 mm long, strongly recurved below pollen-presenter, glabrous; pollen-presenter narrow but slightly swollen at base, almost acute, 0·5–1·5 mm long; stigmatic groove lateral at apex; ovary 1 mm long, glabrous. *Infructescence* spherical, 4–8 cm wide; perianths and styles long-persistent. *Follicles* up to 60, 15–25(30) mm long, 5–8 mm high, 10–15(25) mm wide, in plan view transversely elliptic but often uneven due to crowding; each valve with transverse depression leaving suture as raised ridge with a shoulder each side, loosely hirsute with spreading hairs but becoming glab-

rous where exposed, dark brown, often turning orange-brown, shining or matt, the epidermis sometimes peeling; follicles usually opening only with fire, when open 6–16 mm wide, the valves slightly recurved; lips 0·5–1·5 mm wide; no beak on stylar side. *Seed* cuneate with rounded wing, 20–26 mm long; seed body ± cuneate, 10–14 mm long, 5–13 mm wide, smooth, mottled brown; wing slightly wider on stylar side, 14–24 mm wide, ± decurrent on side opposite style. *Separator* similar to seed in shape and size, thin, often papery.

Banksia sphaerocarpa is a variable species that has caused much difficulty over the years. Much of this has been due to a number of unnamed taxa which are described in this revision, but the species itself remains a group which would benefit from further detailed study. As here circumscribed it is distinguished by the following characters: the presence of a lignotuber; leaves mostly 3–10 cm long, often slightly glaucous; perianth 24–39(55) mm long, hirsute outside, pubescent inside, golden-brown, sometimes yellow; pistil 29–46(65) mm long, golden-brown, purple or maroon; follicles transversely shouldered or ridged, loosely hirsute with straight hairs becoming glabrous, usually shining, dark brown often with orange to gold in exposed areas; body of seed ± cuneate, 5–13 mm wide; separator thin, often papery.

Within the species three varieties are recognised, of which var. *sphaerocarpa* is the most widespread and variable, var. *caesia* also widespread but relatively uniform, and var. *dolichostyla* of restricted range and uniform.

57A. Banksia sphaerocarpa R.Br. var. sphaerocarpa

B. sphaerocarpa R.Br. var. *latifolia* F. Muell. ex Benth., Fl. Austral. 5: 546 (1870). *Type citation:* "Perongerup Range, *Maxwell*". Lecto (here chosen): MEL 16027, annotated by Mueller "Banksia sphaerocarpa Br. var. latifolia". MEL 16026 is an isotype.

Shrub 0·5–2 m tall. *Leaves* dark green, rarely slightly glaucous. *Flowers* ferruginous or purplish-brown, rarely golden. *Perianth* 24–39 mm long. *Pistil* 29–46 mm long. *Follicles* 15–30 mm long, 5–8 mm high, 10–25 mm wide.

Distribution. (Fig. 91) South West Western Australia, in two disjunct regions, one extending from Mt. Lindesay (north of Denmark) east to Cape Riche and inland to the Stirling Range and Chillinup, the other extending from near Encabba south to the Whicher Range and Boyup Brook, mostly on the Darling Plateau.

Selected collections. 4 miles (6 km) N of Badgingarra, 11 April 1964, *A. S. George* 6185 (PERTH); Mogumber Mission, 12 April 1964, *A. S. George* 6200 (PERTH); Chittering Valley, 10 June 1966, *A. S. George* 7768 (AD, CANB, K, MEL, NSW, PERTH); Near Darkin Swamp, on Yarra road off Brookton Highway, 2 Aug. 1980, *E. Berndt* (PERTH); Yoongarillup, Whicher Range, 16 May 1964, *A. S. George* 6211 (PERTH); King George Sound, Feb. 1901, *B. T. Goadby* s.n. (PERTH;) Near Red Gum Pass, Stirling Range, 4 May 1964, *C. A. Gardner* 14705 (PERTH); W end of Porongurup, 30 March 1964, *A. S. George* 6164 (PERTH); Boxwood Hills to Toompup road, 10 km W of Chillilup Pool turnoff, 15 Jan. 1979, *B. Barnsley* 632 (CBG, PERTH).

Habitat. In the south-eastern part of its range, the species occurs in tall shrubland and open scrub or occasionally in low woodland, usually in shallow sandy loam over laterite, sometimes in gravelly clay. In the western sector, it occurs mainly in Jarrah open-forest or woodland, in laterite or shallow sand over laterite. Towards its northern limit, between Mogumber and Encabba, it grows on lateritic rises in open-heath and low shrubland.

Flowering period. January to July

The type of var. *sphaerocarpa* was collected just north of King George Sound and most populations in the south-eastern section of its range are fairly typical and consistent in morphology. There is some variation in leaf length, a few collections having leaves 2·5–4 cm long, e.g. Cheyne Beach, George 6296, and 23 miles south of Borden, Green

390. Flower colour also varies being typically golden brown to ferruginous but sometimes yellow (Green 390). The most noteworthy variant in this region is that named var. *latifolia* F. Muell. which is known from only three collections, the last made in 1952. Of these, two—Maxwell and Atkins—are in flower and one—Preiss 497—in leaf only. No fruits have been seen, and apart from leaf width the specimens appear typical of var. *sphaerocarpa*, with which the variety is here considered synonymous.

Populations occurring between Darkin Swamp and the Whicher Range are also quite typical of this variety. The plants tend to be a little more open in branching habit and in leaf density, and the follicles are sometimes larger (up to 30 mm wide), more acute along the suture, and less shining.

In the area from New Norcia to Chittering where scattered populations occur in Jarrah and Wandoo low woodland, the plants are usually of lower habit than that of southern populations, and the flowers are a little shorter. The perianth limb, although hirsute in early bud, is often almost glabrous in the middle by anthesis. The follicles are fairly typical.

Northern populations of var. *sphaerocarpa*, in the heaths from Eneabba to Mogumber, are also usually of low habit, below 1 m tall. The branchlets remain closely pubescent with curled hairs. The flowers are either golden-brown or pale gold, with perianths 25–28 mm long and styles 29–33 mm long. In the follicles these plants show an approach to *B. micrantha* A. S. George, for they are often very thick, up to 23 mm, and somewhat flattened on top, though retaining the shoulder and loosely hirsute indumentum of var. *sphaerocarpa*. The body of the seed is narrower than that of southern specimens and is usually acute at the base.

57B. Banksia sphaerocarpa R.Br. var. **caesia** A. S. George, var. nov. (Figures 85 and 87A)

Frutex 1·5–4 m altus, ad 4 m diam. *Folia* plerumque caesia. *Flores* aurei. *Perianthium* (25)30–36 mm longum. *Pistillum* (33)40–46 mm longum. *Folliculi* 8–17(22) mm longi, 4–7 mm alti, 10–12(15) mm lati. *Semini corpus* 5–7 mm latum.

Shrub 1·5–4 m tall, to 4 m diam. *Leaves* usually bluish green. *Flowers* golden. *Perianth* (25)30–36 mm long. *Pistil* (33)40–46 mm long. *Follicles* 8–17(22) mm long, 4–7 mm high, 10–12(15) mm wide. *Seed body* 5–7 mm wide.

Type: 4·2 miles (6 km) east of Popanyinning, Western Australia, 20 February 1964, *R. D. Royce* 8118. Holo: PERTH; iso: PERTH (including an infructescence), K, NSW.

Derivation of name. From the Latin *caesius*, pale blue, in reference to the slightly glaucous leaves.

Distribution. (Fig. 91) South West Western Australia, in southern farming districts, from Piawaning south to Kojonup and east to Corrigin and Newdegate.

Selected collections. 4 km E of Piawaning, 20 March 1977, *K. F. Kenneally* 5889 (PERTH); 6·9 miles (11 km E of Wagin along road to Dumbleyung, 19 March 1970, *M. D. Tindale* 147 and *B. R. Maslin* (NSW, PERTH); Yealering, 11 May 1969, *C. F. Davies* (PERTH); 10 miles (16 km) E of Newdegate, 26 Jan. 1964, *A. S. George* 6093 (PERTH).

Habitat. In lateritic gravel or shallow sandy loam over laterite, usually in low or tall shrubland, open-scrub and open-heath; towards the western edge of its range often in low woodland of *Eucalyptus wandoo*.

Flowering period. January to July.

Characters distinguishing var *caesia* from var. *sphaerocarpa* are the larger habit, bluish-green foliage and smaller follicles and seeds. The variety is quite consistent throughout its range, much more so than var. *sphaerocarpa;* this perhaps is a reflection of its geographical range and habitat which are less varied than those of var. *sphaerocarpa*. The two varieties are nowhere sympatric.

Although the follicles are typically smaller than those of var. *sphaerocarpa* there is some overlap especially in collections from the northern and western parts of the range, e.g. Kenneally 5889.

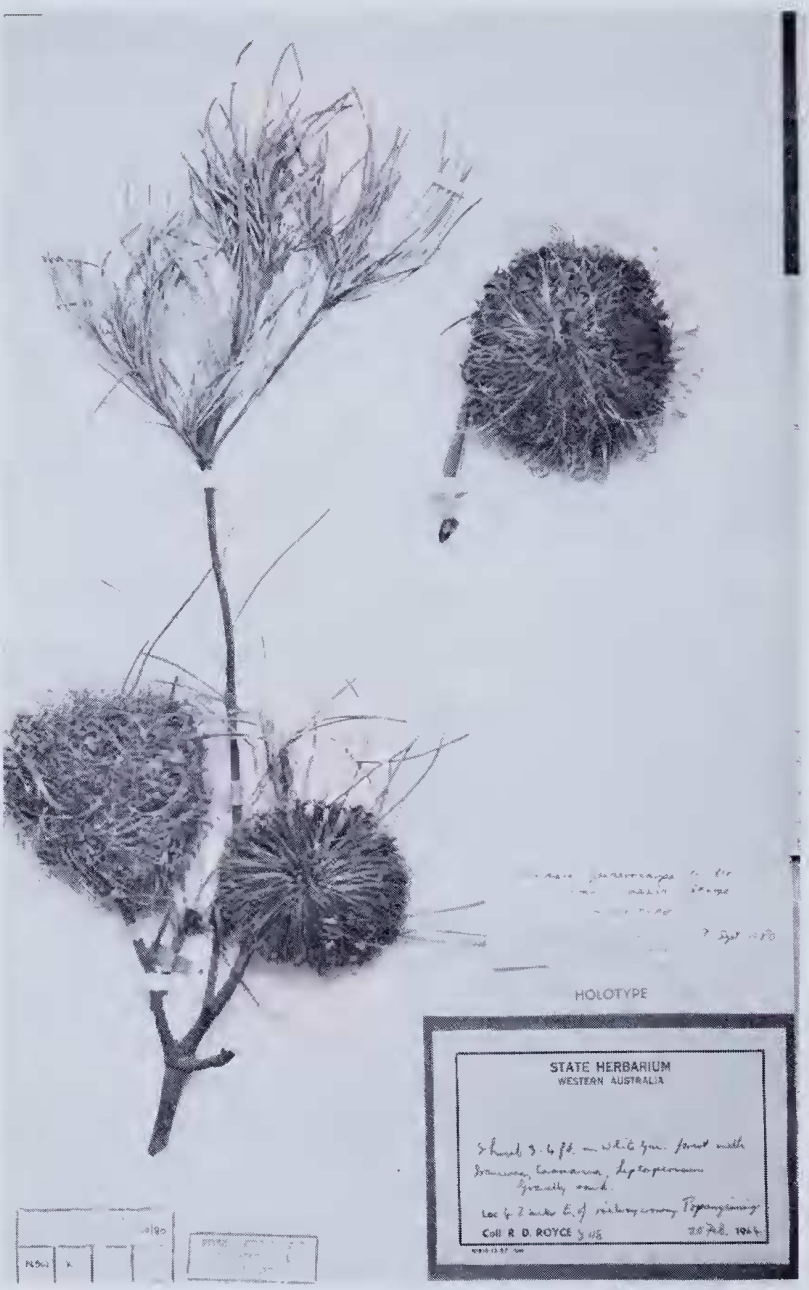


Figure 85. *Banksia sphaerocarpa* var. *caesia*. Holotype, R. D. Royce 8118 (PERTH).

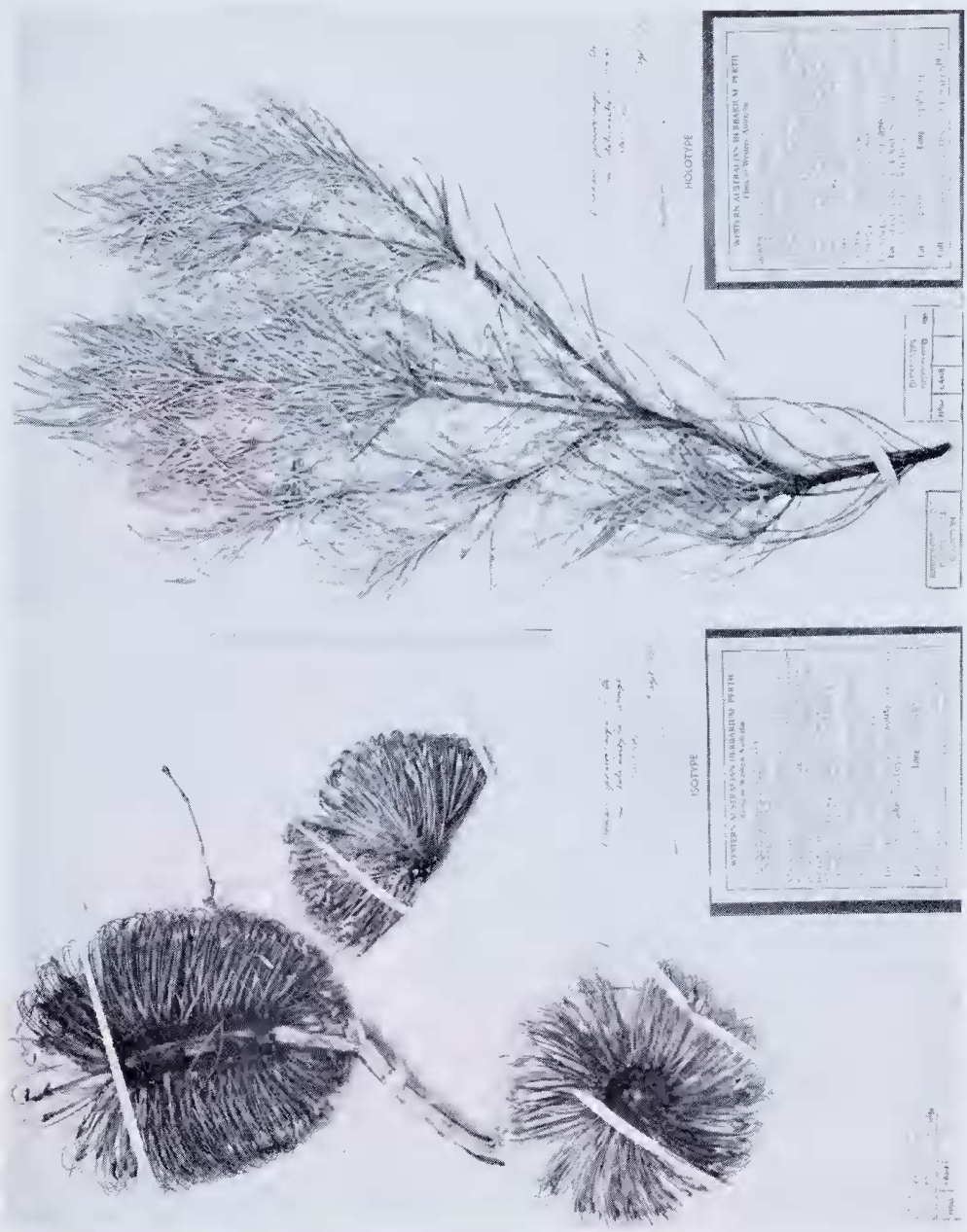


Figure 86. *Banksia sphaerocarpa* var. *dolichostyla*. Holotype and isotype, A. S. George 15106 (PERTH).

57C. Banksia sphaerocarpa R.Br. var. **dolichostyla** A. S. George, var. nov. (Figure 86)

Frutex 2–3 m altus, 3–4 m diam. *Folia* cacsia. *Flores* aurei. *Perianthium* 49–55 mm longum. *Pistillum* 50–65 mm longum. *Folliculi* 15–22 mm longi, 5–8 mm alti, 10–15 mm lati.

Shrub 2–3 m tall, 3–4 m diam. *Leaves* bluish-green. *Flowers* golden. *Perianth* 49–55 mm long. *Pistil* 50–65 mm long. *Follicles* 15–22 mm long, 5–8 mm high, 10–15 mm wide.

Type: Just SSE of South Ironcap, east of Lake Varley, Western Australia, 14 March 1978, *A. S. George* 15106. Holo: PERTH; iso: CANB, NSW, PERTH.

Derivation of name. From the Greek *dolichos*, long, and *stylos*, pillar and hence style, in reference to the very long pistil.

Distribution. (Fig. 91) South West Western Australia: restricted to a small area from Mt. Holland to South Ironcap (east of Hyden).

Selected collections. Eastern slopes of North Ironcap, 6 May 1978, *G. J. Keighery* 1644 (PERTH); Near Mt. Holland east of Hyden, 1 Sept. 1978, *P. Luscombe* s.n.; Mt. Holland, 1934, *H. Steedman* s.n. (PERTH).

Habitat. In lateritic gravel, in low open-woodland and low shrubland.

Flowering period. March to May.

This variety is very similar to var. *caesia* except in its much longer perianth and style, and somewhat larger follicles. Although known from only a few collections it seems consistent and therefore worthy of varietal rank. At the upper end of its range of size, the pistil is the longest of any *Banksia*.

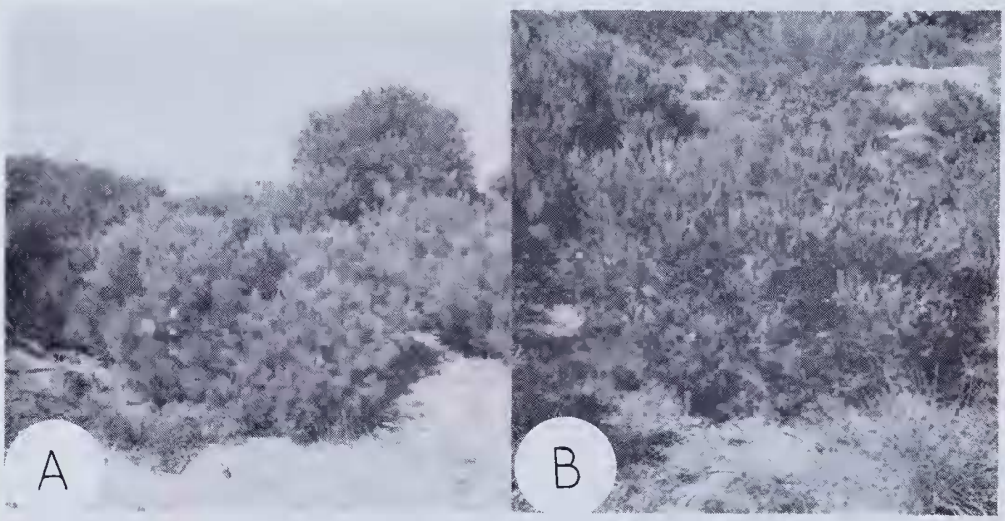


Figure 87. A—*Banksia sphaerocarpa* var. *caesia*. Habit, 1·3 m tall. B—*B. violacea*. Habit, ± 0·8 m tall. (Both E of Kulin, W.A.).

58. Banksia micrantha A. S. George, sp. nov. (Figures 88, 89 and 90)

Frutex ad 60 cm altus cum lignotubero; rami saepe primum rhizomatosi. *Folia* ± conferta, linearia, pungentia, 1–3 cm longa, marginibus arcte revolutis. *Inflorescentia* 2–3 cm longa, 3·5–5 cm diam. sub anthesin. *Bracteae involucrales* 2–4 mm longae. *Bracteae communes* 3–4 mm longae. *Perianthium* 17–20 mm longum limbo 2–3 mm longo includens, extus et intus pubescens. *Pistillum* 19–24 mm longum apice recurvo; pollinis praebitor 0·6–0·7 mm longus. *Folliculi* ovati ad elliptici, 23–27 mm longi, 7–15 mm alti, 20–23 mm lati, ± applanati sed cum porca suturali, ± laeves, pubescentes; flores et pistilla in fructu persistentia. *Semina* late obovata, 20–24 mm longa; seminis corpus obovatum, 12–14 mm longum, 7–9 mm latum, ala 17–23 mm lata.

Type: ± 5 km west of Mt. Lesueur, Western Australia, 27 March 1977, *A. S. George* 14415. Holo: PERTH; iso: K, NSW, PERTH.

Derivation of name. From the Greek *micros*, small, and *anthos*, flower, in reference to the flowers.

Cotyledons (Fig. 9.53) obovate, slightly oblique, widely spreading, 18–20 mm long, 11–15 mm wide, 3-nerved towards base, ± bright green, margin entire to slightly crenulate; auricles ± spreading, obtuse, 1·5–2 mm long. *Hypocotyl* very short, thick, glabrous or loosely hirsute, green. *Seedling leaves* crowded; first two opposite, ± 5 mm above cotyledons, linear, acute, 7–8 mm long, 2–2·5 mm wide, margins recurved, upper surface and midrib below loosely hirsute, lower surface white-tomentose; later leaves becoming narrower, at length 1 mm wide, to 25 mm long, margins tightly revolute, otherwise similar. *Seedling stem* loosely hirsute.

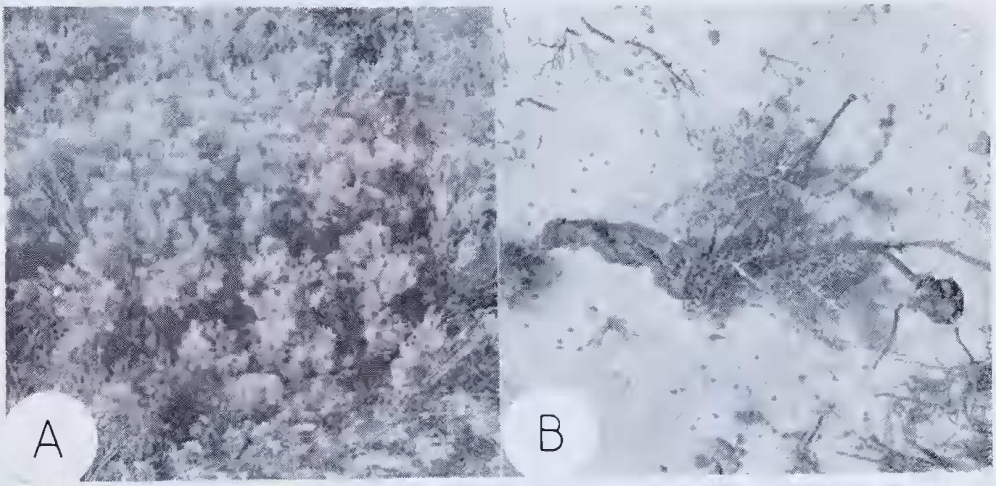


Figure 88. *Banksia micrantha.* A—Habit, ¼ 40 cm tall (W of Mt. Lesueur). B—Part of a plant showing underground stems, aerial stems, regrowth following fire, and old infructescence (Near Mt. Peron, W.A.).

Mature plant a shrub up to 60 cm tall and 1·2 m diam. with lignotuber. *Stems* erect or spreading, often rhizomatous in the soil for a short distance from the lignotuber, the underground parts with filiform, hirsute bracts 2–5 mm long. *Branchlets* pubescent with short, crisped hairs. *Leaves* ± crowded, erect, linear, 1–3 cm long, 1–1·5 mm wide, pungent; margins tightly revolute, leaving midrib exposed; lamina sparsely hirsute or almost glabrous above when young becoming glabrous; new leaves bright green. *Inflorescence* terminal or on lateral branch, the peduncle leafy or with subulate deciduous bracts, 3·5–5 cm across after anthesis. *Axis* 1·5–3 cm long, 3–4 mm wide, 11–13 mm with common bracts. *Involucral bracts* subulate from thick bases, 2–4 mm long, closely pubescent. *Common bracts* linear, 3–4 mm long, densely ferruginous-hirsute; exserted apex conical, obtuse, upturned, shortly tomentose, white to grey. *Floral bracts* slightly shorter, with smaller exserted apex. *Flowers* pale yellow, sometimes purplish, in bud greenish-pink or -mauve with green limb. *Perianth* 17–20 mm long including limb of 2–3 mm; claws filiform, 0·2–0·3 mm wide, shortly appressed-pubescent outside, appressed-pubescent inside except glabrous midrib; limb narrowly elliptic, obtuse, thick, appressed-pubescent at apex and base and sometimes on margins, otherwise glabrous. *Anthers* ± 1·5 mm long, connective shortly produced. *Hypogynous scales* linear, often lobed, 1·5 mm long. *Pistil* 19–24 mm long, gently curved, glabrous, apex bent down at ± 90°; pollen-presenter 0·6–0·7 mm long, ± ovoid, brown; stigmatic groove transverse at apex; ovary glabrous. *Infructescence* 4–6 cm across; old perianths and styles persistent. *Follicles* up to 25, in plan view ovate-elliptic, 23–27 mm long, 7–15 mm high, 20–23 mm wide, somewhat flattened on top but with a low ridge along the suture; valves rhombic-hemispherical, ± smooth,

pubescent with short straight hairs becoming glabrous, when young bright green; follicles opening usually with fire, to 12 mm across, the valves slightly recurved; lips ± 0·5 mm wide. *Seed* broadly obovate, 20–24 mm long; seed body obovate, 12–14 mm long, 7–9 mm wide, stylar side straight and beaked to stylar point; inner face slightly convex, outer flat, dark brown, slightly mottled; wing slightly offset to stylar side, 17–23 mm wide, decurrent on side opposite style, mottled brown. *Separator* similar to seed in shape and size, thin.

Distribution. (Fig. 91) South West Western Australia, restricted to an area between Eneabba and Cervantes.

Figure 89. *Banksia micrantha.* Holotype, A. S. George 14415 (PERTH).

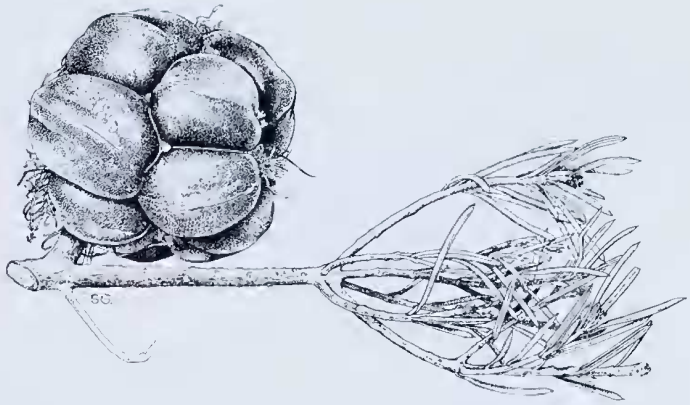


Figure 90. *Banksia micrantha*. Infructescence x $\frac{3}{4}$. Drawn from A. S. George 14415.

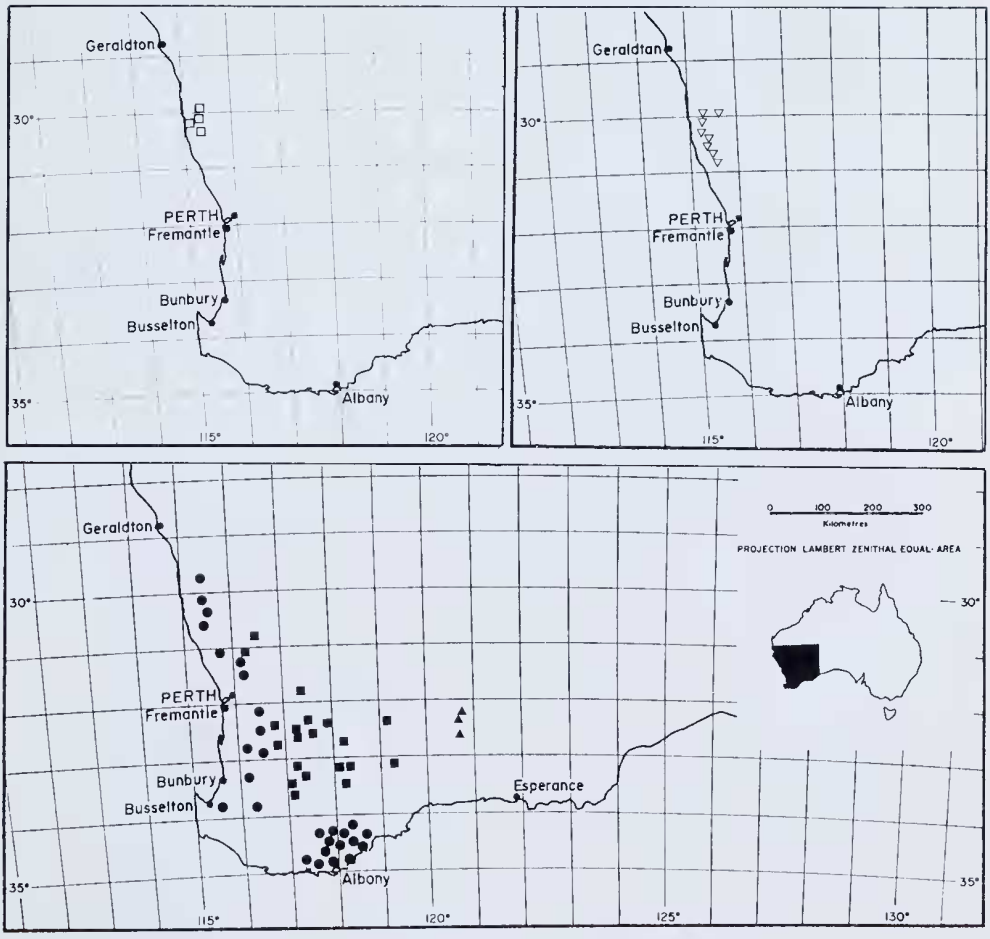


Figure 91. Distribution of *Banksia sphaerocarpa* var. *sphaerocarpa* (●), *B. sphaerocarpa* var. *caesia* (■), *B. sphaerocarpa* var. *dolichostyla* (▲), *B. micrantha* (□), and *B. grossa* (▽).

Selected collections. South of Eneabba, 9 March 1974, *A. S. George* 11782 (PERTH); Between Cockleshell Gully and Mt. Lesueur, August 1938, *W. E. Blackall* 3611 (PERTH); Mt. Lesueur, Hill River, January 1940, *C. A. Gardner* s.n. (PERTH).

Habitat. In shallow grey or white sand over laterite, in low shrubland or open-heath.

Flowering period. January to May, with a few inflorescences as late as September.

Banksia micrantha is closely related to *B. sphaerocarpa*, especially its northern populations, but is distinct enough to be given specific status. The principal differences of *B. micrantha* are its sprawling habit, very pungent leaves, small appressed-pubescent perianth, almost glabrous perianth limb, and large follicles with a close indumentum of short, appressed straight hairs. It is also related to *B. incana* A. S. George from which it can most readily be distinguished by the pubescent inner surface of the perianth, the infructescence with persistent old flowers, and the slightly shouldered brown follicles which are sparsely pubescent with straight hairs.

Banksia micrantha has the most restricted distribution of the species in the series *Abietinae*. It is centred around Mt. Lesueur, an area proposed as a nature reserve but not yet declared as such and currently threatened by proposed open-cast coal mining. It is not yet generally in cultivation as it is not well known.

Although the specific characters are consistent, there is variation in some features, especially in the size of the follicles.

In its low, sprawling habit the species shows a tendency towards the prostrate state. In particular some of the lateral branchlets at first develop underground for up to 60 cm before emerging to continue as aerial branchlets. Where underground they are covered with linear-subulate bracts giving them a rhizomatous aspect.

59. Banksia grossa A. S. George sp. nov. (Figures 92 and 93)

Frutex ad 1 m altus cum lignotubero. *Folia* ± sparsa, linearia, obtusa, 4–12 cm longa, (1)1·8–2·8 mm crassa, marginibus arcte revolutis. *Inflorescentia* 5–7 cm longa, 8–9 cm diam. sub anthesin. *Bracteae involucrales* 5–7 mm longae. *Bracteae communes* 7–9 mm longae. *Perianthium* 35–45 mm longum limbo 5–6 mm long includens, extus et intus hirsutum; limbus hirsutus. *Pistillum* 38–48 mm longum, glabrum; pollinis praebitor 1 mm longus; ovarium glabrum. *Folliculi* elliptici, 20–45 mm longi, 10–18 mm alti, 10–18 mm lati; valvi laeves, hirsuti; sutura obtusa; flores et pistilla in fructu persistentia, ± appressa. *Semina* late obovata, 28–39 mm longa; seminis corpus anguste-cuneatum, 14–18 mm longum, 4–9 mm latum; ala 27–33 mm lata.

Type: 45 miles (76 km) north of Regans Ford on Brand Hwy, Western Australia, 14 May 1969, *A. S. George* 9316. Holo: PERTH; iso: CANB, K, NSW.

Derivation of name. From the Latin *grossus*, coarse, in reference to the appearance of the leaves, flowers and fruit which are more coarse than other species of the *Abietinae*.

Cotyledons (Fig. 9.54) obovate, 16–22 mm long, 9–12 mm wide, convex or concave, ± recurved, 3-nerved, ± bright green; auricles obtuse, descending, 2 mm long. *Hypocotyl* moderately stout, short, loosely pilose, pale red. *Seedling leaves:* first two 6–8 mm above cotyledons, ± opposite, broadly linear, obtuse, 14–16 mm long, margins revolute but not concealing lower surface; upper surface hirsute with white spreading hairs, lower surface white-woolly; next leaves also in ± opposite pairs, similar but longer. *Seedling stem* reddish, hirsute.

Mature plant a shrub 70 cm to 1 m tall with many erect stems arising from a lignotuber. *Stems* with flaky pale brown bark. *Branchlets* hoary-tomentose with short crisped hairs and scattered longer ones, the latter soon deciduous; prophylls at base of branchlet few or none, terete, tomentose, soon deciduous. *Leaves* erect, straight or slightly curved or flexuose, obtuse but the midrib shortly produced as a hard, obtuse apex; 4–12 cm long, (1)1·8–2·8 mm broad, thick; lamina closely pubescent above with short crisped hairs, becoming glabrous; margins closely revolute against midrib, the latter flat, prominent, not or slightly sunken, pubescent with short crisped hairs becoming glabrous; petiole 3–5 mm long, pubescent. *Inflorescence* on short, thick, lateral branchlet usually towards the base of the stem, occasionally terminal, usually cylindrical, 8–9 cm diam. at anthesis; a few leaves close below inflorescence. *Axis* 5–7 cm long, 7–9 mm wide, 21–24 mm with common bracts. *Involucral bracts* covering ± 5 mm of branchlet below spike, subulate

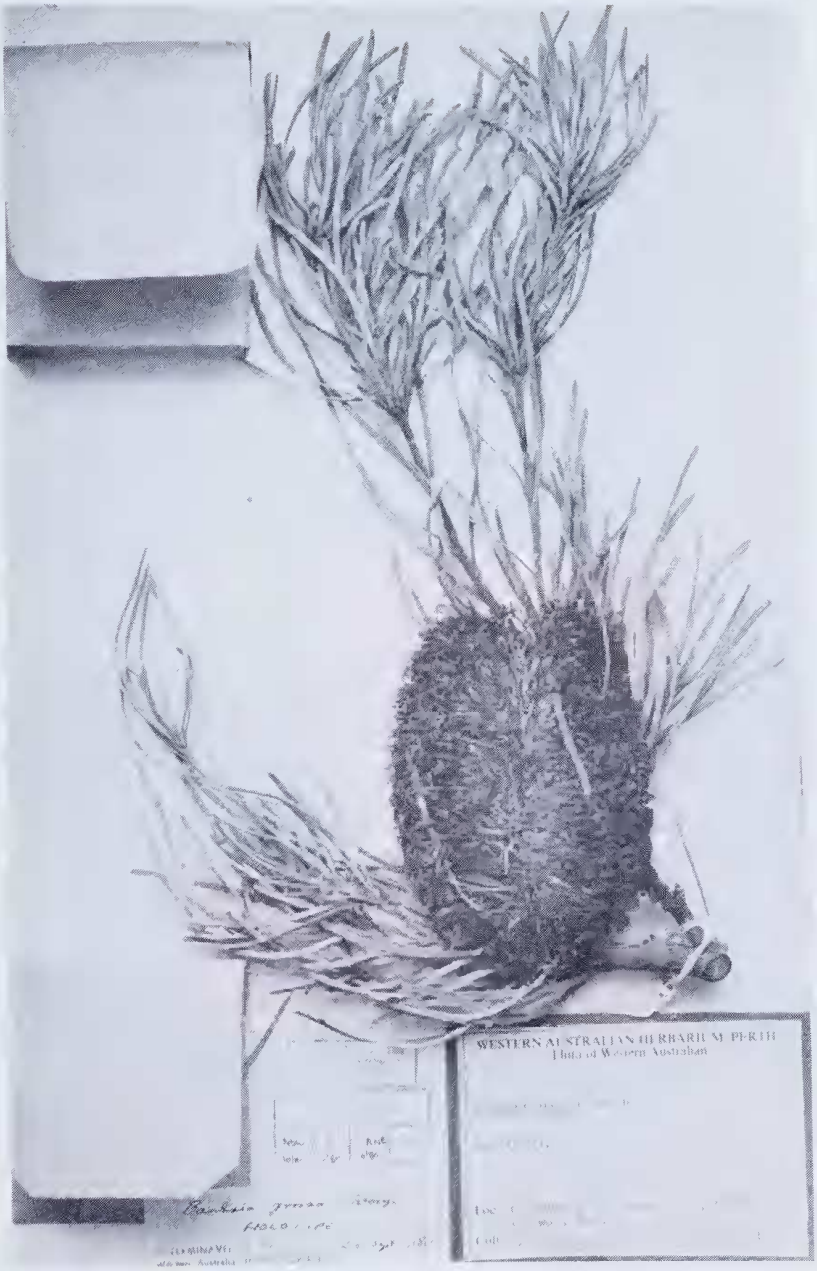


Figure 92. *Banksia grossa*. Holotype, A. S. George 9316 (PERTH).

Figure 93. *Banksia grossa.* Infructescence x $\frac{2}{3}$. Drawn from A. S. George 6750.

from swollen bases, 4–7 mm long, closely tomentose with short, crisped, hairs, grey to pale grey-brown. *Common bracts* linear-subulate, 7–9 mm long; exserted apex conical, grey, slightly upturned. *Floral bracts* similar but slightly shorter, apex ferruginous. *Flowers* ferruginous to golden brown, the styles usually dark red to purple where exposed. *Perianth* 34–45 mm long including limb of 5–6 mm: claws filiform, hirsute outside with long coarse straight to flexuose hairs, hirsute inside with straight ferruginous hairs, densely so near base; limb narrowly elliptic, obtuse, densely hirsute with ± straight hairs. *Anthers* narrowly elliptic, ± navicular, 2 mm long, connective shortly produced. *Hypogynous scales* oblong, ± 2 mm long, acutely and unevenly 2–4-lobed, cohering to perianth for ± 1 mm. *Pistil* slightly curved, then strongly so towards apex, 38–48 mm long, stout, glabrous; pollen-presenter ± ovoid ,± 1 mm long; stigmatic groove lateral at apex; style slightly constricted below pollen-presenter; ovary glabrous. *Infructescence* ± ellipsoidal, 6–10 cm long, 4–8 cm wide; old perianths persistent, the styles curling stiffly against follicles; common and floral bracts slightly enlarged and indurated. *Follicles* (20–)25–35(–45) mm long, 10–18 mm high, 10–18 mm wide; valves semicircular, convex, smooth, very hirsute with straight, spreading hairs eventually wearing off exposed areas; ridge obtuse; suture scarcely evident; follicles opening usually with fire, 3–11 mm at widest, not recurving; lips ± 1 mm wide, dark brown. *Seed* unequally obovate, 28–39 mm long; seed body narrowly cuneate, base acute, apex obliquely acute to rounded, 14–18 mm long, 4–9 mm wide, dark grey-brown and flecked on inner surface, pale brown and flecked on outer surface; wing 27–33 mm wide, decurrent on side opposite style, dark brown with large pale flecks on inner face, brown and slightly flecked on outer face. *Separator* similar to seed in size and shape, concave next to the seed body, dark brown, the wings recurved.

Distribution. (Fig. 91) South West Western Australia, between Eneabba and Regans Ford.

Selected collections. 8 km S of Eneabba, 27 April 1977, *R. J. Hnatiuk* 770025 (PERTH); NE of Mt. Lesueur, 27 March 1977, *A. S. George* 14429 (PERTH); Coorow Reserve, 30 June 1967, *C. Chapman* s.n. (AD, BRI, CANB, K, MEL, NSW, PERTH); Cadda Road, 5 miles (8 km) from Badgingarra, 30 May 1965, *F. W. Humphreys* s.n. (PERTH); 3 km S of Cataby Brook, Brand Hwy, 26 March 1977, *A. S. George* 14406 (PERTH).

Habitat. In shallow white or grey sand over laterite, sometimes in deeper sand, in open-heath, low shrubland or in tall shrubland.

Flowering period. March to September, with the peak in winter.

Banksia grossa is a recent discovery, the first collection being that of F. W. Humphreys in 1965. Although the opening of the region to agriculture made it more accessible, it is surprising that the species was not collected by earlier visitors, but perhaps they were diverted by its similarity to *B. leptophylla* and *B. sphaerocarpa*. The overall character of the species is captured in its name, for in the thick leaves, large perianths, and prominent follicles, the last enclosed by the thick styles, it has a coarse aspect not seen in the other species of the *Abietinae*. The flaking bark is also unusual, for the only other species with similar bark is *B. nutans* in which, however, the layers are papery and of various shades of dull red and brown. The seeds are the largest of the *Abietinae*.

The plants typically produce inflorescences on short branchlets lateral to the main stems near their base, but occasionally terminal inflorescences are produced. The flowers produce copious nectar. The leaves, as indicated above, are usually wider than in all other *Abietinae* except the short, broad-leaved variant of *B. sphaerocarpa* from the Porongurups, but several collections have more slender leaves about 1 mm wide, e.g. Cockleshell Gully, A. C. Burns 153 (PERTH).

60. Banksia leptophylla A. S. George, nom. nov.

Based on *Banksia pinifolia* Meissner, Hook. Journ. Bot. & Kew Gard. Misc. 7: 118 (1855), non Salisb. (1796).

Type citation: "Drummond, coll. vi. n. 199." Lecto (here chosen): K; iso: BM, CGE, G, K, LD, MEL (3 sheets), P. There is no sheet at NY.

Derivation of name. From the Greek *leptos*, fine or slender, and *phyllon*, a leaf, in reference to the slender leaves which are less rigid than in most other species of the genus.

B. sphaerocarpa R.Br. var. *pinifolia* auctt. e.g. Blackall, How to Know W. Austral. Wildfl. p: 130 (1954). The name has not been validly published.

B. sphaerocarpa R.Br. var. *major* auctt. e.g. Fairall, W. Austral. Nat. Pl. in Cult., p.67 (1970). The name has not been validly published.

Cotyledons (Fig. 9.55) oblong to narrowly obovate, straight or slightly curved, ± spreading, 13–16 mm long, 3·5–4 mm wide, ± nerveless, bright green; auricles descending, acute, 2·5 mm. *Hypocotyl* slender, 7–8 mm long, glabrous or pubescent, pale pinkish green. *Seedling leaves* at first opposite, higher leaves scattered; first leaves linear, obtuse, 8–17 mm long, hirsute above, white-tomentose below, the margins somewhat recurved leaving lower surface exposed; higher leaves longer, narrower, with margins progressively more revolute. *Seedling stem* densely pubescent with matted white hairs and loosely hirsute with long straight hairs.

Mature plant a shrub to 2 m tall, 3 m wide, without lignotuber, much branched and moderately dense. *Branchlets* tomentose with curled hairs at first ferruginous, later pale brown; subulate prophylls at base of branchlet deciduous. *Leaves* erect, slightly curved, linear, acute, 4–10 cm long, 1–1·5 mm wide, the petiole 1–2 mm long, ± erect against branch; upper surface hirsute to pubescent with straight hairs becoming glabrous, often minutely scabrid; midrib below pubescent with long straight and short curled hairs becoming glabrous; lower surface white-tomentose; margins closely revolute, midrib slightly sunken on lower surface. *Inflorescence* on lateral branchlet usually concealed within the shrub, spherical to ± ovoid, 7–12 cm diam. at anthesis; subtending branchlets leafy; upper 1 cm of main stem with subulate, broad-based bracts up to 1 cm long, densely

tomentose. *Axis* 3–10 cm long, 7–9 mm wide, 20–30 mm wide with common bracts. *Involucral bracts* subulate with thickened bases, 5–10 mm long, densely tomentose, ferruginous to grey-brown. *Common bracts* linear, 10–12 mm long, densely hirsute with ferruginous hairs; exserted apex conical, often produced into an acute point, densely tomentose, ferruginous, pale brown or cream. *Floral bracts* linear, 8–10 mm long; apex small, obtuse; indumentum as in floral bracts. *Flowers* pale to medium yellow or brown, always brown when fading; style yellow, rarely purple. *Perianth* 33–45 mm long including limb of 3–5 mm, ± straight with reflexed limb; claws filiform, 0·4–0·5 mm wide above tube tapering upwards, pubescent to shortly hirsute on both sides; limb narrowly elliptic, hirsute or pubescent, the apical hairs longer. *Anthers* 2 mm long, the connective shortly produced. *Hypogynous scales* oblong, irregularly lobed, 2–3 mm long. *Pistil* 34–58 mm long, slightly curved, the apex turned down at 90°–110°, glabrous; pollen-presenter 0·9–1·2 mm long, slightly thicker than apex of style, upper 1/4 pale, remainder dark; stigmatic groove terminal, slightly oblique; ovary glabrous. *Infructescence* spherical, 6–10(12) cm diam.; old flowers persistent; common and floral bracts slightly enlarged, indurated, sometimes pungent. *Follicles* up to 80, sometimes more, in plan view elliptic, 15–30(35) mm long, 5–12 mm high, 6–10(14) mm wide; valves semi-circular to semi-elliptic, convex, smooth, densely hirsute with spreading hairs becoming glabrous where exposed; ridge obtuse, sometimes slightly undulate; suture very fine; follicles opening usually with fire, to 10 mm across; lips ± 1 mm wide. *Seed* broadly obovate, 25–29 mm long; seed body ± oblong but narrowed to acute base, 12–15 mm long, 3–4 mm wide, mottled dark and pale brown on both sides; wing 15–27 mm wide, decurrent down seed body on side opposite style, outside mottled brown, inside dark brown. *Separator* similar to seed in shape and size.

Distribution. (Fig. 97) South West Western Australia, in near-coastal regions from Kalbarri to Guilderton, extending inland to Tathra National Park, Moora and Mogumber.

Selected collections. Rabbit Proof Fence, Kalbarri, 10 June 1968, *R. Gliddon* s.n. (PERTH); Burma road, SE of Walkaway, 21 Aug. 1966, *A. C. Burns* 7 (CANB, MEL, NSW, PERTH); Beekeepers' Reserve, 5 km W of Poodaloo Well, in 29°41′S, 115°07′E, 2 June 1977, *R. Hnatiuk* 770050 (PERTH); 12 km S of Jurien-Coomallo road along Cervantes road, 26 May 1977, *A. S. George* 14412 (PERTH); 25 miles (40 km) S of Lancelin, 2 July 1961, *A. S. George* 2623 (PERTH); 14 miles (22 km) SW of Three Springs, 10 Dec. 1961, *A. S. George* 3227 (PERTH); 12 miles (20 km) W of Mogumber, 5 Jan. 1967, *K. Newbey* 2671 (PERTH).

Habitat. In deep white or grey sandy clay or sand, in shallow depressions (rarely damp) in tall shrubland and open heath; near the coast often in shallow yellow or brown sand over limestone; rarely in laterite. Often locally common.

Flowering period. December to August.

Although *Banksia leptophylla* is variable it is not practical to formally divide it into infraspecific taxa, largely due to the lack of suitable morphological characters. There are two principal variants, one with large flowers produced in summer and one with smaller flowers produced in winter. Each shows variation and there are intermediates. The fruit are perhaps the most variable feature, for individuals of the smaller variant produce both small and large infructescences. The common bracts also vary, those of large-flowered variants usually being obtuse, while those of small-flowered plants range from obtuse to acutely pointed. The flowers are typically medium yellow (both perianths and styles) but are sometimes pale brown, sometimes cream; rarely the upper styles are purple; in all cases the flowers turn brown with age after anthesis. The new leaves are ferruginous.

The closest relatives of *B. leptophylla* are *B. lanata* A. S. George and *B. telmatiaea* A. S. George. The former is usually easy to distinguish on the basis of its small bushy habit, its crowded leaves that are deep pink when new, its white common and floral bracts, and its cream and purple flowers. A few small-flowered specimens of *B. leptophylla*

have pale flowers and pale brown indumentum of the floral bracts, e.g. George 14412 from the lower Hill River; Cranfield s.n., near Drovers Cave National Park. The late-spring flowering season of *B. lanata* differs from that of small-flowered *B. leptophylla*. *Banksia telmatiaea* is usually distinguished by its short leaves, its cylindrical inflorescences, its shorter golden-brown perianth and its thinner follicles. A collection, in fruit and very early bud, which appears intermediate is George 14414 from near the lower Hill River, in which the leaves are 2–4 cm long and the follicles 4–7 mm wide.

Figure 94. *Banksia lanata*. Holotype, A. S. George 11191 (PERTH).

61. Banksia lanata A. S. George, sp. nov. (Figure 94)

Frutex nanus ad 1 m altus sine lignotubero. *Folia* anguste-linearia, acuta, 3–10 cm longa, supra hirsuta deinde glabra vel minute scabrida, marginibus arcte revolutis. *Ramuli* tomentosi. *Inflorescentiae* sphaericae, 3–5 cm longae, 7–10 cm latae sub anthesin. *Bracteae involucrales* ± confertae, subulatae, 5–10 mm longae, villoso-tomentosae. *Bracteae communes* lineares, 7–9 mm longae pilis albis dense hirsutae, apicibus acutis sursum curvatis. *Perianthium* cremeum, 32–38 mm longum limbo 3–4·5 mm includens, utrinque breviter hirsutum; limbus dense hirsutus. *Pistillum* 38–48 mm longum, glabrum; pollinis praebitor anguste conicus, 1 mm longus. *Folliculi* elliptici, 12–30 (35) mm longi, 4–11 mm alti, 6–12 mm lati, laeves, dense hirsuti; bracteae communes induratae, ± pungentes; flores et pistilla in fructu persistentia. *Semina* obovata, 17–25 mm longa; seminis corpus late falcatum, 9–13 mm longum; 5-6 mm latum; ala 18–27 mm lata.

Type: E of Eneabba on Winchester road, Western Australia, in 29°48′S, 115°27′E, 14 Nov. 1971, *A. S. George* 11191. Holo: PERTH; iso: CANB, NSW.

Derivation of name. From the Latin *lanatus*, woolly, in reference to the white hairs of the common and floral bracts.

Cotyledons (Fig. 9.56) narrowly obovate, gently curved, 13–17 mm long, 5–7 mm wide, nerveless (3-nerved towards base when dry), bright green, spreading; auricles spreading or descending, acute, 3 mm long. *Hypocotyl* slender, ± 1 cm long, pubescent becoming glabrous, reddish. *Seedling leaves* at first in pairs or scattered, upper ones scattered; first 3–6 leaves 4–6 mm above cotyledons, linear to narrowly lanceolate, obtuse, 12–20 cm long, sparsely hirsute above with spreading hairs, white-woolly below; margins only slightly recurved; next few leaves up to 4 cm long, narrowly linear, the margins more revolute, otherwise similar; higher leaves crowded, very narrow, acute, 6–7 cm long, the margins tightly revolute, moderately densely hirsute above. *Seedling stem* above cotyledons sparsely hirsute, higher up hirsute and densely tomentose.

Mature plant a shrub to 1 m tall without a lignotuber, much-branched and spreading; branchlets densely leaved and usually concealing flowers and fruits. *Branchlets* densely white-tomentose with curled hairs and scattered long straight hairs; base of branchlet with persistent, subulate, tomentose prophylls 5–15 mm long. *Leaves* crowded, narrowly linear, usually curved, acute to acuminate but scarcely pungent, 3–10 cm long, 0·75–1 mm wide; upper surface hirsute with short and long straight hairs becoming glabrous and very slightly scabrid; midrib hirsute below becoming glabrous; margins tightly revolute, concealing white-woolly undersurface; petiole 3–4 mm long, tomentose; new leaves deep pink. *Inflorescence* usually on short lateral leafy branchlet from a stem 2–4 years old, spherical, 7–10 cm across at anthesis; branchlet for 1–3 cm below inflorescence with subulate bracts on thickened bases, 5–10 mm long, woolly at base, tomentose above. *Axis* 3–5 cm long, 4–5 mm wide, 19–22 mm wide with common bracts. *Involucral bracts* similar, crowded, persistent. *Common bracts* linear, 7–9 mm long, densely hirsute with creamy white (rarely pale brown) hairs; exserted apex conical but narrowed to acute upturned point, densely tomentose. *Floral bracts* linear, 6–7 mm long, densely hirsute, obtuse. *Flowers* pale cream, sometimes pale brown, the styles purple. *Perianth* 32–38 mm long including limb of 3–4·5 mm, ± straight with reflexed limb; claws filiform, ± 0·5 mm wide tapering upwards, shortly hirsute on both sides with ± spreading white or pale brown hairs; limb narrowly elliptic, densely hirsute especially at apex. *Anthers* 1·5 mm long on short filaments, the connective shortly and obtusely produced. *Hypogynous scales* oblong, obtusely lobed, 2 mm long, adhering to perianth. *Pistil* 38–48 mm long, gently sigmoid, the apical 3–4 mm recurved through 90°–130°, glabrous; pollen-presenter narrowly conical, 1 mm long, slightly swollen near base, lower half dark, upper pale; stigmatic groove transverse at apex; ovary glabrous. *Infructescence* spherical, 4·5–6 cm diam., old perianths and styles persistent; common bracts somewhat enlarged, indurated, ± pungent, greyish. *Follicles* up to 50, elliptic in plan view, 12–30(35) mm long, 4–11 mm high, 6–12 mm wide; valves semi-elliptic, smooth, convex, densely hirsute with spreading hairs, the exposed parts becoming glabrous; ridge obtuse; suture fine; follicles opening usually with fire, to 18 cm across, valves gently recurved; lip ± 1 mm wide; inner surface brownish black. *Seed* broadly obovate, 17–25 mm long; seed body broadly falcate to almost semi-circular, 9–13 mm long, 5–6 mm wide, obtuse at base, apex produced to beak on stylar margin which is concave, the other margin very convex; both surfaces ± flat, brownish grey; wing 18–27 mm wide, brown. *Separator* similar to seed in shape and size.

Distribution. (Fig. 97) South West Western Australia: confined to an area between Arrowsmith Lake, Coomallo Creek and Tathra National Park.

Selected collections. Between Lake Logue and Arrowsmith River, 27 Aug. 1948, *C. A. Gardner* 9114 (PERTH); ± 41 miles (65 km) SW of Three Springs, 16 Dec. 1964, *F. W. Humphreys* s.n. (PERTH); SW of Eneabba, 17 Oct. 1969, *A. S. George* 9794 (PERTH); Coomallo Creek, in 30°11'S, 115°23'E, 15 Dec. 1976, *R. Hnatiuk* 761397 (PERTH).

Habitat. In deep white sand, sometimes over laterite, in closed or open heath.

Flowering period. Late October to January.

Banksia lanata is closely related to *B. scabrella* A. S. George and *B. leptohpylla* A. S. George but can be distinguished from both by the low bushy habit, the deep pink new leaves and the white (rarely pale brown) hairs of the common and floral bracts. From *B. scabrella* it is further differentiated by the longer leaves, the upturned shorter apices of the common bracts, the larger pollen-presenter and the more rounded sutures of the follicles. Additional differences from *B. leptophylla* are the cream and purple flowers, the usually more prominent follicles and the ± pungent enlarged common bracts of the infructescence.

The species is locally common over its range, usually growing on the lower slopes of the gently undulating hills of the region. Although its occurrence is within that of *B. leptophylla* the latter usually occupies a slightly different habitat lower down the slopes and on the valley floors.

62. Banksia scabrella A. S. George, sp. nov. (Figures 95 and 96)

Frutex ad 2 m altus, 3 m latus, sine lignotubero, ramulis patentibus saepe prostratis. *Folia* linearia, patentia, acuta, 8–28 mm longa, supra pubescentia-hirsuta deinde scabrida, marginibus arcte revolutis. *Ramuli* tomentosi. *Inflorescentia* cylindrica-ovoidea, 3–6 cm longa, 7–9 lata sub anthesin. *Bracteae involucrales* confertae, subulatae, 2–8 mm longae, tomentosae. *Bracteae communes* lineares, 6–10 mm longae, apicibus subulatis recurvis. *Perianthium* 27–35 mm longum limbo 3–5 mm includens, utrinque breviter hirsutum; limbus breviter hirsutus apice hirsuto. *Pistillum* 35–45 cm longum, glabrum; pollinis praebitor angustus, 0·75–1 mm longus. *Folliculi* anguste elliptici, 18–28 mm longi, 5–9 mm alti, 6–8 mm lati, ± laeves, dense hirsuti deinde glabri; bracteae induratae, prominentes; flores et pistilla in fructu ± persistentia. *Semina* obovata, 24–28 mm longa; seminis corpus anguste-obovatum ad falcatum, 13–15 mm longum, 4–5 mm latum; ala 14–25 mm lata.

Type: SE of Walkaway, Western Australia, 4 Sept. 1966, *A. S. George* 7860. Holo: PERTH; iso: AD, CANB, K, NSW.

Derivation of name. From the Latin *scaber*, rough, with the diminutive suffix—*ella* to denote the scabrid leaves.

Cotyledons (Fig. 9.57) narrowly obovate, curved, ± spreading, 12–14 mm long, 3–4 mm wide, bright green, nerveless; auricles spreading or descending, acute, 2–3 mm long. *Hypocotyl* slender, 12–17 mm long, finely pubescent, reddish. *Seedling leaves* scattered, the first 3–5 mm above cotyledons; lowest leaves linear, obtuse, 4–15 mm long, sparsely hirsute above and on midrib below, white-woolly below, the margins revolute but not concealing lower surface; higher leaves to 25 mm long, acute, the margins more revolute, otherwise similar. *Seedling stem* hirsute and closely pubescent.

Mature plant a shrub without lignotuber, to 2 m tall and 3 m wide, much-branched, the branches often spreading and the lowermost often resting on the ground. *Branchlets* white-tomentose with short curled hairs and sparsely hirsute, the long hairs wearing off; many subulate tomentose prophylls at base. *Leaves* ± crowded, widely spreading to ascending, narrowly linear, acute, 8–28 mm long, ± 1 mm wide, pubescent and hirsute above when young, becoming glabrous after 1–2 years but remaining scabrous with persistent hair-bases; midrib sunken below, hirsute becoming glabrous; lower surface white-woolly but concealed by tightly revolute margins; petiole ± appressed to stem, tomentose. *Inflorescence* terminal or on lateral branchlet, usually conspicuous, ± cylindrical—ovoid, 7–9 cm wide at anthesis; branchlet leafy to spike except the last 1–1·5 cm which is covered with dense subulate bracts 2–8 mm long on somewhat thickened bases, woolly-tomentose with grey to brown hairs, the lowest bracts often deciduous before anthesis. *Axis* 3–6

Figure 95. *Banksia scabrella*. Holotype, A. S. George 7860 (PERTH).

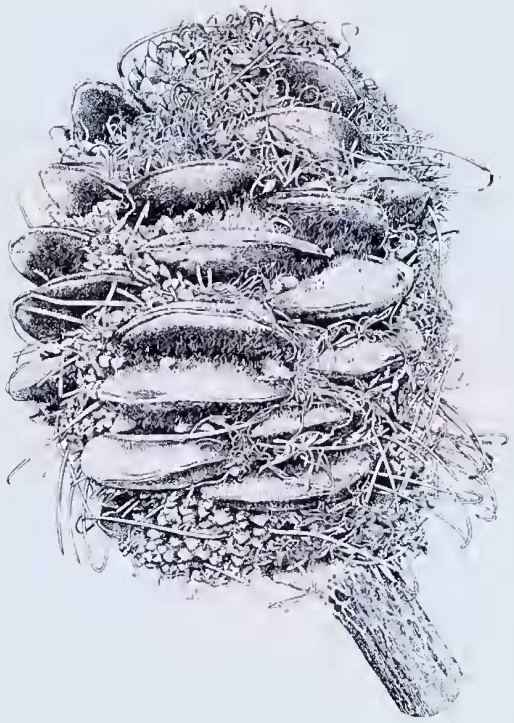


Figure 96. *Banksia scabrella.* Infructescence x $\frac{3}{4}$. Drawn from A. S. George 7860.

cm long, 5–6 mm wide, 18–20 mm wide with common bracts. *Common bracts* linear, 6–10 mm long, densely hirsute with ferruginous hairs: exserted apex subulate, downturned, pubescent with white curled hairs. *Floral bracts* similar but slightly narrower and shorter. *Flowers* cream to pale yellow, the upper ones including styles purple. *Perianth* 27–35 mm long including limb of 3–5 mm; claws filiform, 0·5 mm wide tapering upwards, shortly hirsute to pubescent inside and outside; tube hirsute inside in upper half; limb fusiform, acute, slightly thickened at base, shortly hirsute outside, the hairs longer at apex. *Anthers* 1·3–1·8 mm long, on filaments 0·5–0·75 mm long; connective dark, shortly produced. *Pistil* 34–45 mm long, curved upwards towards middle, apical 4–5 mm bent down at 90°–130°, glabrous; pollen-presenter scarcely thickened, 0·75–1 mm long, dark at base, pale at apex; stigmatic groove terminal; ovary glabrous except a few straight hairs at apex. *Hypogynous scales* subulate, 2 mm long, cohering to perianth. *Infructescence* spherical-ovoid, 6–8 cm diam., the old flowers persistent for 1–2 years but then deciduous excepting a few remnants; common and floral bracts enlarged and indurated giving an echinate aspect between the follicles. *Follicles* up to 80, narrowly elliptic in plan view, 18–28 mm long, 5–9 mm high, 6–8 mm wide; valves semi-elliptic, smooth to slightly rugose, evenly convex, densely hirsute with spreading hairs becoming glabrous where exposed; ridge narrow, often slightly undulate; suture fine; follicles mostly remaining closed until burnt, when open 5–14 mm across, slightly recurved; lips ± 1 mm wide. *Seed* broadly obovate, 24–28 mm long; seed body narrowly obovate to falcate, 13–15 mm long, 4–5 mm wide, obtuse at base, apex produced to shallow beak at stylar point; inner surface ± flat with thickened upper half, slightly rugose, mottled dark brown; outer surface slightly convex, brown with a few dark streaks; wing 14–24 mm wide, dark brown with a few darker flecks. *Separator* similar to seed in shape and size.

Distribution. (Fig. 97) South West Western Australia, confined to a small area E and SE of Walkaway.

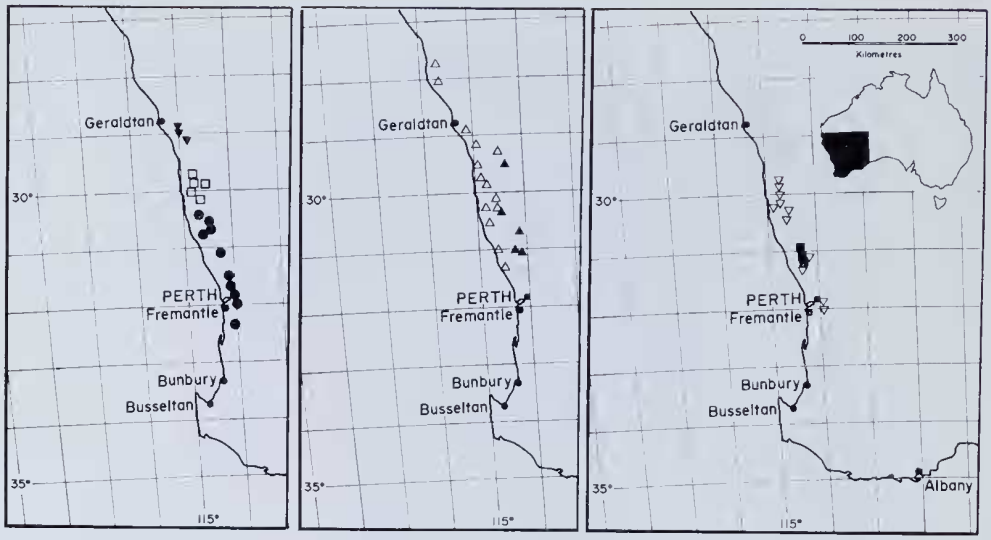


Figure 97. Distribution of *Banksia leptophylla*—winter flowering (△), summer flowering (▲), *B. lanata* (□), *B. scabrella* (▼), *B. telmatiaea* (●), *B. laricina* (■), and *B. incana* (▽).

Selected collections. Greenough River, Nov. 1877, *F. Mueller* (MEL); Walkaway, Nov. 1963, *F. W. Humphreys* (PERTH); E of Allanooka, Oct. 1961, *S. M. Harvey* (PERTH); Geraldton, 15 Oct. 1897, *M. Brown* (E).

Habitat. In deep white or pale yellow sand, in open heath and low shrubland.

Flowering period. September to January.

Banksia scabrella is a distinctive species among the *Abietinae*, characterised by the sprawling habit, the short scabrid leaves, the subulate common bracts, the yellow and purple flowers, and the prominent indurated bracts of the infructescence. It is the only species of the series with markedly scabrid leaves and elongated apices to the common and floral bracts, the last character seen in only two other species of the genus, *B. coccinea* R.Br. and *B. laevigata* Meissner.

Its closest relative in the series is probably *B. leptophylla* with which it is sympatric over its small range. *Banksia leptophylla* is usually more densely branched with longer smooth leaves, acute (not subulate) common bracts, golden brown flowers and smaller follicles. *Banksia scabrella* also approaches *B. lanata* in the flower colour, the latter being typically cream with reddish purple colouring where exposed to more sunlight. The spreading habit and larger follicles of *B. lanata* are also similar to those of *B. scabrella*, though the latter is unique in having lower branchlets which lie on the ground. This tendency towards the prostrate habit is accentuated by such branchlets often producing inflorescences which also rest on the ground.

63. Banksia telmatiaea A. S. George, sp. nov. (Figures 98 and 99)

Frutex ad 1 m altus sine lignotubero. *Folia linearia*, obtusa vel acuta, 1·5–3(4) cm longa, supra hirsuta deinde glabra, infra albo-lanata, marginibus revolutis. *Inflorescentia* cylindrica-ellipsoidea, 3–5 cm longa, 4–7 cm lata sub anthesin. *Bracteae involucrales* subulatae, 3–4 mm longae, tomentosae. *Bracteae communes* 7–8 mm longae apicibus acutis. *Perianthium* 22–25 mm longum limbo 4 mm longo includens, utrinque breviter hirsutum; limbus pubescens apice hirsuto. *Pistillum* 25–29 mm longum, glabrum; pollinis pracbitor anguste-oblongus, 1 mm longus. *Folliculi* anguste elliptici, 12–20 mm longi, 4–9 mm alti, 4–7 mm lati, valvis semicircularibus laevibus dense hirsutis; flores et pistilla in fructu persistentia. *Semina* obovata, 19–23 mm longa; seminis corpus oblongum, 10–13 mm longum, 2–3 mm latum; ala 14–18 mm lata.

Type: 28 miles (± 45 km) N of Regans Ford on Brand Hwy, Western Australia, 14 May 1969, *A. S. George* 9309. Holo: PERTH; iso: CANB.

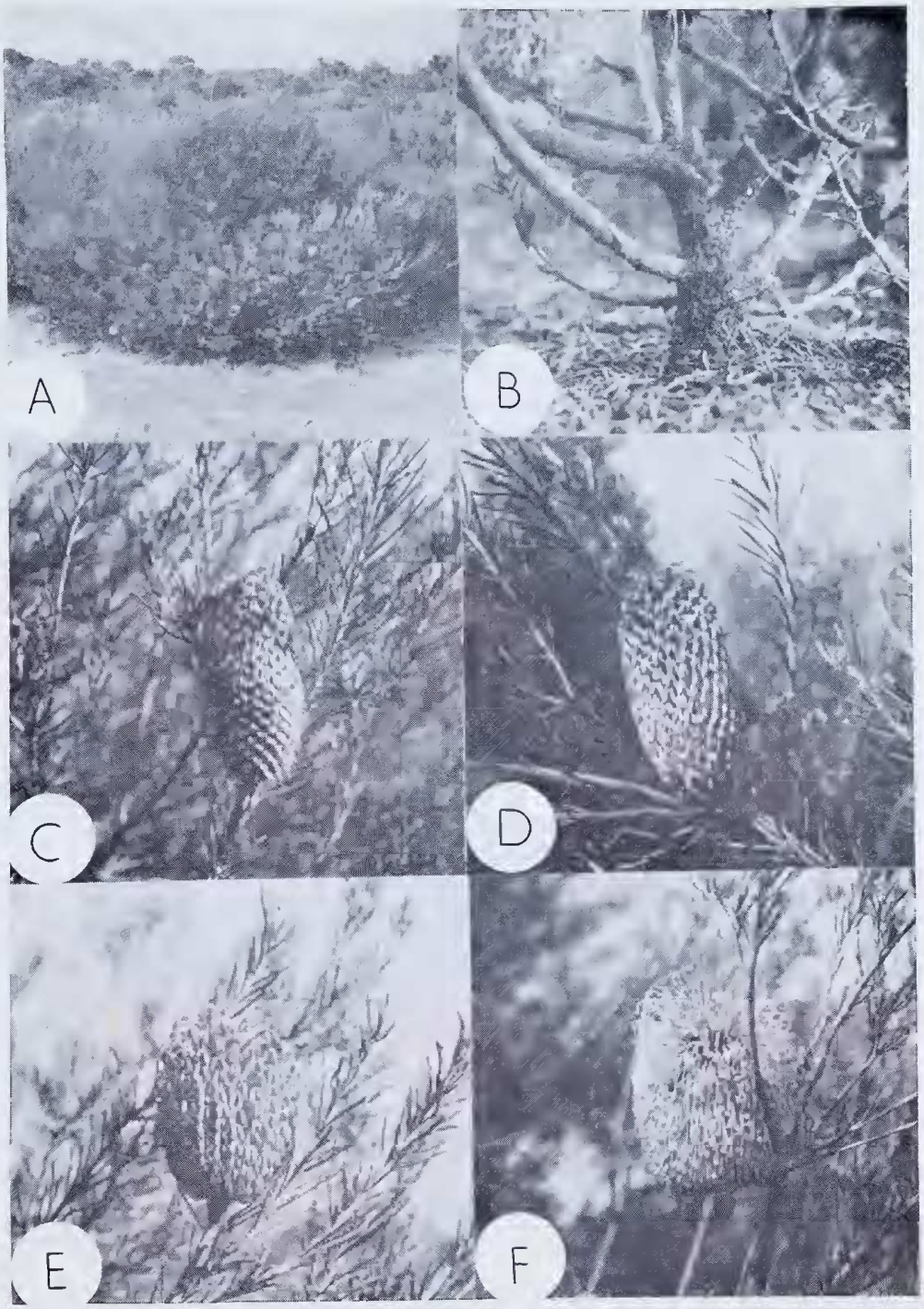


Figure 98. *Banksia telmatiaea*. A—Habit, 1·5 m tall. B—Single basal stem. C to F—Development of inflorescence showing changes in curvature of flowers, and basipetal development. (All Orange Grove, W.A.).

Figure 99. *Banksia telmatiaea*. Holotype, A. S. George 9309 (PERTH).

Derivation of name. From the Greek *telmatiaeos*, of a marsh, in reference to the swampy habitat of the species.

Cotyledons (Fig. 9.58) narrowly obovate, spreading, 12–17 mm long, 2–4 mm wide, dull green, ± nerveless; auricles spreading, acute, 2–3 mm long. *Hypocotyl* slender, 2–3 mm long, glabrous, green or red. *Seedling leaves* at first in opposite pairs, the lowest 3–5 mm above cotyledons, linear, obtuse, 8–18 mm long; upper surface and midrib below loosely hirsute; lower surface white-woolly, not concealed by recurved margins; upper leaves scattered, up to 2·5 cm long, otherwise similar but narrower with margins more closely revolute. *Seedling stem* hirsute with spreading hairs and closely pubescent with short curled hairs.

Mature plant a shrub to 2 m tall (usually taller than wide) without lignotuber, with a single basal stem, much branched-above. *Branchlets* hoary-tomentose with matted, crisped white hairs and a few longer ones; a few subulate prophylls at base. *Leaves* erect or somewhat spreading, or slightly incurved, linear, obtuse to acute, shortly mucronate, 1·5–3(4) cm long, 1–1·3 mm wide, petiole 1·5–2 mm long; margins closely revolute; midrib sunken towards apex on lower side, less so or not at all towards base; upper surface of lamina sparsely pubescent with short appressed hairs becoming glabrous, smooth or very slightly scabrous; midrib on lower surface sparsely hirsute with long hairs, soon glabrous or with a few crisped hairs towards base which persist on petiole; matted white hairs of lower surface of lamina visible on each side of midrib; new growth at first pale brown but soon becoming bright green. *Inflorescence* on lateral leafy branchlet from older (more than 4 years) stem within shrub, cylindrical to ellipsoidal, 4–7 cm wide at anthesis. *Axis* 3–5 cm long, 4–5 mm wide, 18–20 mm wide with common bracts. *Involucral bracts* over 3–8 mm of top of branchlet, subulate from narrowly triangular bases, recurved, 3–4 mm long, closely woolly-tomentose, white or pale brown. *Common bracts* 7–8 mm long, linear but broader upwards, densely hirsute with ferruginous hairs where enclosed; exserted apex conical, somewhat upturned, acute, tomentose with crisped, pale hairs. *Floral bracts* shorter, narrower. *Flowers* golden to pale brown; styles cream. *Perianth* 22–25 mm long including reflexed limb ± 4 mm long; claws filiform, shortly hirsute inside and outside with translucent-white hairs; tube hirsute inside in upper half; limb narrowly elliptic, acute, appressed-pubescent with short, translucent hairs that are longer at apex. *Anthers* narrowly elliptic, ± navicular, ± 1·5 mm long, connective shortly produced. *Hypogynous scales* oblong, acutely and irregularly lobed, ± 2 mm long, cohering with perianth for ± 1 mm. *Pistil* 25–29 mm long, slightly sigmoid, strongly bent down below apex, glabrous; pollen-presenter narrowly oblong but narrower at base, ± 1 mm long; stigmatic groove terminal, oblique; ovary ± 1 mm long, glabrous. *Infructescence* spherical, ovoid or obovoid, 3·5–6 cm long, 4·5–6 cm diam.; old flowers persistent; bracts somewhat enlarged, indurated. *Follicles* up to 65, in plan view narrowly elliptic, 12–20 mm long, 4–9 mm high, 4–7 mm wide; valves ± semicircular to semi-elliptic, ± smooth, dark brown, densely hirsute with long, spreading hairs, the exposed parts becoming glabrous; ridge obtuse; suture fine; follicles usually opening with fire, to 8–11 mm; lips ± 0·8–0·9 mm wide, dark brown; valves smooth inside, dark greyish-brown. *Seed* obovate, 19–23 mm long; seed body oblong, 10–13 mm long, 2–3 mm wide; obtuse at base, upper margin curved; outer surface grey-brown mottled, inner black; wing 14–18 mm wide, unequally expanded, brown, longitudinally mottled, darker on inner side; decurrent 1/2–3/4 way down seed body. *Separator* similar to seed in plane shape and size.

Distribution. (Fig. 97) South West Western Australia, W of the Darling Scarp between Badgingarra and Serpentine.

Selected collections. 115·9 km NNW of Gingin by road, 2 Sept. 1970, *T. E. H. Aplin* and *R. Coveny* 3154 (NSW, PERTH); Chandalla, 6 June 1919, *F. M. C. Schock* (PERTH); Cannington, June 1923, *C. A. Gardner* s.n. (PERTH); Serpentine, May 1901, *L. Diels* and *E. Pritzel* 411 (PERTH).

Habitat. In deep grey sandy loam, wet in winter, in open scrub, closed or open heath, or sometimes low open-woodland.

Flowering period. May to August.

Although closely related to *Banksia leptophylla* A. S. George, and in northern areas showing sometimes a tendency to intergrade with that species, *B. telmatiaea* is regarded as worthy of specific rank. It typically has short leaves, a cylindrical inflorescence, with flowers shorter and follicles smaller than in *letpophylla*. In most localities it grows in swamps, whereas *leptophylla* usually occurs in deep, well-drained sand. The winter flowering season is much more clearly defined than the summer and winter flowering of *leptophylla*.

The species was first collected in the late 1830s—early 1840s by Preiss and Drummond and has until now been included with *Banksia sphaerocarpa* R.Br., e.g. by Meissner (1856) and Bentham (1870).

64. Banksia laricina C. Gardner

J. Roy. Soc. W. Austral. 47: 57 (1964).

Type citation: "Hab. in dist. Darling prope flumen Moore et Beermullah, in arenosis depressis subhumidis, fl. m. Jun.–Julio, Gardner 12840". Holo: PERTH, a collection from Beermullah, Gardner 12840, and labelled by him "Type Specimen"; iso: PERTH; syn: PERTH, a collection by Gardner labelled Moore River. Both collections were made in July 1958 and contain only flowering material.

Cotyledons (Fig. 9.59) narrowly obovate, 10–12 mm long, 4–7 mm wide, slightly curved, ± nerveless, medium green, the margin sometimes red; auricles descending, acute, 1·5 mm long. *Hypocotyl* slender, appressed-pubescent, green. *Seedling leaves* not recorded.

Mature plant a shrub to 1·7 m tall without lignotuber. *Stem* single at base, much-branched above. *Branchlets* when young sparsely hirsute with long straight hairs and hoary with short, crisped hairs, the former soon disappearing, ± densely leaved, often without bracts at base but sometimes with a few deciduous narrowly subulate prophylls 3–4 mm long. *Leaves* scattered but usually crowded, linear, spreading, straight or slightly recurved, acute, ± pungent, bright green, 5–15 mm long, ± 0·8 mm broad; margins revolute, the midrib below flat and sunken; upper surface sparsely hirsute, soon glabrous; midrib below sparsely hirsute with long hairs, soon glabrous; petiole 1–1·5 mm long, pubescent with short, crisped hairs. *Inflorescence* on short leafy, lateral branchlet, occasionally terminal but then with a whorl of lateral branchlets immediately below, obovoid to doliform, 5 cm broad at anthesis. *Axis* 1·5–2·5 cm long, 2–3 mm wide, 6–7 mm wide with common bracts. *Involucral bracts* along 5–15 cm of branchlet below spike, subulate, 2–3 mm long; base swollen, tomentose with crisped hairs, the apex glabrous. *Common bracts* oblong, flat, broadened upwards, 2 mm long, densely hirsute with pale-ferruginous hairs; exserted apex shortly conical, upturned, obtuse, with shorter curled hairs, grey. *Floral bracts* similar but narrower and shorter. *Flowers* pale yellow including styles, but perianth drying red-brown. *Perianth* 17–19 mm long including limb of 2–2·5 mm, somewhat bent downwards above base, then straight, much relaxed after anthesis; claws filiform, flat, ± 0·1 mm wide, appressed-pubescent outside with straight hairs, glabrous inside; limb fusiform, almost acute, appressed-pubescent. *Anthers* broadly elliptic, 1–1·3 mm long. *Hypogynous scales* oblong, obtusely 2-lobed, ± 1 mm long, free from each other but adhering to perianth at base. *Pistil* ± 27–30 mm long, glabrous, apex recurved; pollen-presenter ± ovoid, obtuse, ± 0·3 mm long, somewhat wrinkled around base; apex pale, the stigmatic groove lateral, ovary glabrous, ± 0·5 mm long. *Infructescence* of up to 25 follicles, ± spherical, 8–9 cm diam., the old flowers early deciduous; common and floral bracts indurated but almost obscured except at base and apex of spike. *Follicles* 22–23 mm long, 19–27 mm high, 14–18 mm wide at base, much thinner above; valves ± semi-circular, slightly oblique, somewhat undulate; closely tomentose with short crisped hairs and scattered longer ones, persistent only on the thickened base; ridge obtuse; suture prominent; follicles opening widely to 12–20 mm, bent at from top of thickened portion; lips 3–4 mm wide, dark brown; inner surface ± undulate but smooth, pale brown. *Seed* obovate, 27–35 mm long; seed body ± narrowly cuneate, 9–11 mm long, 3–4 mm wide, anti-stylar margin ± straight, stylar margin curved with stiff "beak"; inner surface dark brown, slightly undulate, glistening, outer surface ± unevenly ridged,

with pale and dark brown longitudinal bands; wing obovate, 17–24 mm wide, somewhat oblique, decurrent almost to base of seed body on side opposite style, brown, inner surface mottled, outer surface smooth, glistening. *Separator* similar to seed in size and shape.

Distribution. (Fig. 97) South West Western Australia, restricted to a small area north and south of the Moore River near Regans Ford.

Selected collections. 24 miles (39 km) N of Gingin, 14 Nov. 1960, *A. S. George* 1697 (PERTH); Reserve 28462 S of Regans Ford, 9 June 1969, *R. D. Royce* 8594 (PERTH).

Habitat. In deep white sand on flats or slight depressions, usually in low open-woodland of *Banksia menziesii*, *B. attenuata*, *Eucalyptus todtiana* and occasionally *Melaleuca preissiana*.

Flowering period. Late April to July.

Banksia laricina is very distinctive in its fruit, the follicles being greatly expanded and narrowed towards the suture. Other characteristics are the lack of a lignotuber, the small common and floral bracts, and the glabrous inner surface of the perianth. The species is consistent in morphology, with variation only in the size of the follicles.

Relationships appear to be with those members of the *Abietinae* in which the perianth is glabrous inside, and the perianths and styles are deciduous in fruit—*B. incana* A. S. George, *B. pulchella* R.Br., and *B. meisneri* Lehm. Perhaps the closest link is with *B. incana* which also has large follicles though not produced upwards as in *B. laricina*. *Banksia incana* has slightly larger flowers, thicker, longer leaves and a lignotuber. Both *B. pulchella* and *B. meisneri* share the absence of a lignotuber but have much smaller leaves, flowers and follicles. *Banksia laricina* regenerates vigorously from seed following fire, and is possibly a recent development from *B. incana* taking advantage of Tertiary sands on the coastal plain.

65. Banksia incana A. S. George sp. nov. (Figure 100 and 101)

Frutex ad 70 cm altus cum lignotubero. *Ramuli* tomentosi. *Folia* linearia, pungentia, 1–6 cm longa, marginibus arcte revolutis. *Inflorescentia* 2–3 cm longa, 6–7 cm diam. sub anthesin. *Bracteae involucrales* 1–3 mm longae. *Bracteae communes* 3–4 mm longae apicibus complanati-conicis. *Perianthium* 21–23 mm longum limbo 2–2·5 mm longo includens, extus appresso-pubescens, intus glabrum; limbus extus fere glaber. *Pistillum* 30–35 mm longum apice arcte recurvo; pollinis praebitor 0·5 mm longus. *Folliculi* elliptici-rhomboidei, 18–33 mm longi, 4–16 mm alti, 10–30 mm lati, crassi parce porcati, laeves, pubescentes, pilis crispis; flores et pistilla dehiscentia. *Semina* late obovata, 25–30 mm longa; seminis corpus anguste-cuneatum 10–15 mm longum, 4–6 mm latum; ala 20–25 mm lata.

Type: Outside Mogumber Mission, Western Australia, 2 Feb. 1967, *A. S. George* 8644. Holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW, PERTH, RSA.

Derivation of name. From the Latin *incanus*, hoary, in reference to the grey, closely pubescent follicles.

Banksia sphaerocarpa R.Br. var. *glabrescens* Meissner in DC. Prodr. 14: 453 (1856). *Type citation:* "Drum. (i.e. Drummond) coll. 1, sine numero, et 2, n. 337! v.s. in. herb. DC. et Shuttl." Lecto (here chosen): NY—a flowering specimen of Drummond 337, ex Herb. Shuttleworth and annotated by Meissner "var. calycis lobis glabratis"; syn: (all Drummond 337) BM, CGE, G, K, LD, MEL, OXF, P.

Cotyledons (Fig. 9.60) narrowly obovate, slightly curved, 14–16 mm long, 6 mm wide, ± nerveless, bright green; auricles acute, descending, 1·5–2 mm long. *Hypocotyl* 10–12 mm long, glabrous, pale red. *Seedling leaves* moderately crowded; first two 2–3 mm above cotyledons, linear, acute, 9–10 mm long, the margins loosely revolute; upper surface and midrib below loosely hirsute with spreading straight hairs; lower surface visible, white tomentose; next 10 or so leaves to 1·9 cm long, otherwise similar; higher leaves to 3 cm long, more tightly revolute and concealing lower surface except a narrow line of white wool. *Seedling stem* loosely hirsute; lateral branches developing immediately above cotyledons within a year.

Mature plant a shrub to 70 cm tall and 1 m wide with many stems arising from a lignotuber. *Branchlets* hoary-tomentose with short, crisped hairs and longer straight ones, the former persisting for ± 2 years; ± leafy throughout, the leaves more crowded towards apices, a few deciduous prophylls at base. *Leaves* scattered, erect to spreading, linear,

Figure 100. *Banksia incana*. Holotype, A. S. George 8644 (PERTH).

Figure 101. *Banksia incana*. Infructescence x $\frac{3}{4}$. Drawn from A. C. Burns 14.

straight or slightly curved, acute with a pungent mucro, 1–6 cm long, 1·5–2 mm broad, petiole 1–2 mm long; margins closely revolute against midrib which is flat or slightly convex, slightly sunken or level with margins; upper surface at first pubescent with straight, to ± spreading appressed hairs, becoming glabrous; midrib below hirsute with straight slightly spreading hairs; short, curled hairs evident between midrib and lamina; petiole shortly pubescent; new leaves bright green. *Inflorescence* ± spherical, 6–7 cm broad, on lateral branchlet from stem at least 2 years old, the branchlet bare or leafy to involucral bracts. *Axis* 2–3 cm long, 3–4 mm wide, 8–10 mm wide with common bracts. *Involucral bracts* few, subulate from thickened bases, 1–3 mm long, densely tomentose with short crisped hairs, pale ferruginous, persistent through flowering. *Common bracts* linear, 3–4 mm long, densely hirsute with straight, ferruginous hairs becoming shorter and crisped at apex; exserted apex conical but flattened, upturned, pale brown. *Floral bracts* similar but narrower. *Flowers* bright yellow including styles, occasionally slightly reddish towards apex of inflorescence. *Perianth* 21–23 mm long including limb of 2–2·5 mm; claws linear, after anthesis cohering and flat except towards limb, 3-nerved, appressed-pubescent outside, the basal hairs retrorse; glabrous inside; limb narrowly elliptic, obtuse, base and apex hirsute with straight hairs, otherwise glabrous; perianth relaxed after anthesis so that style exceeds it by ± 1 cm. *Anthers* 1–1·3 mm long. *Hypogynous scales* oblong, irregularly and obtusely lobed, ± 1 mm long. *Pistil* 30–35 mm long, slightly curved above base, apex strongly recurved through 90°–180°, glabrous; pollen-presenter ± ovoid, obtuse, ± ribbed, 0·5 mm long; stigmatic groove lateral at apex; ovary glabrous, ± 0·75 mm long. *Infructescence* ± spherical, 4–7 cm diam., the old flowers soon deciduous; common and floral bracts slightly enlarged, indurated, but few visible between follicles except where latter not developed. *Follicles* up to 36, 18–33 mm long, 4–16 mm high, 10–30 mm wide; valves ± elliptic to rounded-rhomboid, very thick and rounded at base, produced to sutural ridge, obtuse; suture fine; grey-hoary with short, crisped, appressed, persistent hairs; opening with fire narrowly to 2–8 mm, not recurving; lips ± 1 mm wide, dark brown; inner surface of follicle shining, brown. *Seed* 25–30 mm long; seed body narrowly cuneate to oblong, acute or obtuse at base, strongly curved on antistylar side with decurrent wing, ± straight on the other, 10–15 mm long, 4–6 mm wide; inner surface shining, finely mottled brown and cream, outer surface dull, mostly brown, with a few short ridges; wing 20–25 mm wide, decurrent on one side of seed body, dark brown inside, grey-brown outside. *Separator* similar to seed in size and shape, dark brown, somewhat mottled on inner face.

Distribution. (Fig. 97) South West Western Australia, between the Arrowsmith River and Perth.

Selected collections. S of Eneabba, 30 Oct. 1978, *E. A. Griffin* 1381 (PERTH); Coomallo Creek, in 30°11'S, 115°23'E, 15 Dec. 1976, *R. J. Hnatiuk* 761395 (PERTH); W of NW corner of Badgingarra National Park, 26 March 1977, *A. S. George* 14411 (PERTH); Near Gingin, July 1943, *C. A. Gardner* s.n. (PERTH); Belmont, Nov. 1925, *H. Steedman* (PERTH); Orange Grove, 28 Jan. 1972, *A. S. George* 11259 (CANB, PERTH).

Habitat. In deep sand or sand over laterite, in open- or closed-heath, tall shrubland or low open-woodland, often associated with *Banksia menziesii* and *B. attenuata.*

Flowering period. November to April, sometimes continuing into winter.

Banksia incana may be recognised by the presence of a lignotuber, the bright yellow flowers, the perianth which is quite glabrous inside, the almost-glabrous limb, and the large follicles which are closely tomentose with short curled hairs, with the old perianths and styles early deciduous. The foliage is usually grey-green. When the follicles are fully grown but not mature, they are green along the ridge grading to red-brown at the base. In common with most lignotuberous species of the genus, many inflorescences set no fruit, but the flowers are early deciduous. The follicles open only a little on being burnt, the thick valves scarcely recurving.

The species shows variation especially in the leaves and follicles. The leaves are usually erect and 1–3 cm long, but in some collections they are up to 6 cm long, while in others they are widely spreading and only 1–2 cm long. The follicles, as in most species with closely-packed fruit, are often somewhat irregular in shape and size. In some collections they are consistently small for the species, in others large. Habit and floral morphology are relatively uniform. Relationships with *B. micrantha* and *B. laricina* are discussed under these species.

66. Banksia violacea C. Gardner (Figure 87B)

Journ. Roy. Soc. W. Austral. 13: 62 (1928).

Type citation: "Hab. in distr. Stirling, ab Lake Grace orientem versus, in arenosis fruticetis apertis, fl. m. Decem. (C. A. Gardner)". Holo: PERTH, labelled by Gardner "TYPE Banksia violacea, Gardn. Small shrub, flrs deep violet. Lake Grace, C. A. Gardner, 14 Dec. 1926". Iso: K, PERTH.

B. sphaerocarpa R.Br. var. *violacea* auctt. e.g. Blackall. How to Know W. Austral. Wildfl, 1:130 (1954). The combination has not been validly published.

Cotyledons (Fig. 9.61) oblong to broadly linear, curved, spreading, 15 mm long, 3 mm wide, ± bright green, nerveless; auricles spreading, very acute, 3 mm long. *Hypocotyl* slender, 15–18 mm long, loosely hirsute, greenish-red. *Seedling leaves* at first in opposite pairs, the first pair close to cotyledons or up to 5 mm above, linear, obtuse, spreading, 7–13 mm long, loosely hirsute above, white-woolly below, the margins recurved but not concealing lower surface; higher leaves ± crowded, up to 20 mm long, otherwise similar but with more revolute margins. *Seedling stem* hirsute. Lateral branchlets often developing just above cotyledons within a year.

Mature plant a shrub to 1·5 m tall and 1 m broad, usually with a single basal stem, much-branched above, rarely with many stems arising from a lignotuber. *Branchlets* pubescent with short crisped and long ± straight hairs, the hairs sometimes persistent for 1–2 years, sometimes becoming glabrous within a year; subulate prophylls crowded on basal 1 cm of branchlet but soon deciduous, above densely leaved throughout. *Leaves* scattered, erect, linear, obtuse, rarely acute, mostly 1–2 cm long, sometimes to 3 cm or as short as 7 mm, ± 1·5 mm wide, petiole 1–2 mm; margins tightly revolute, touching midrib which is flat or gently convex and slightly depressed; lamina above and midrib below loosely hirsute with straight, appressed hairs soon becoming glabrous; petiole pubescent with crisped hairs becoming glabrous; new leaves bright green. *Inflorescence* on lateral leafy branchlet, ± spherical, 6–7 cm diam. at anthesis. *Axis* 2–3 cm long, 3–4 mm wide, 10–12 mm wide with common bracts; basal 5 mm of axis without flowers.

Involucral bracts subulate from thick, ± elongate bases, 2–3 mm long, tomentose or outer surface ± glabrous. *Common bracts* oblong, 2·5–3·5 mm long, densely hirsute with straight ferruginous hairs; exserted apex obtuse, upturned, tomentose with paler hairs. *Floral bracts* smaller, apices shorter. *Flowers* dark violet, sometimes greenish at base, rarely yellowish; styles green or purple; all turning brown after anthesis. *Perianth* 21–27 mm long including limb of 2–3 mm, relaxed at anthesis so that style exceeds it by 12–18 mm; claws linear-filiform, 0·2–0·3 mm wide, pubescent outside with straight, ± appressed hairs, hirsute inside in upper part of tube and on lower claws, glabrous above; margins in upper part of tube inside thickened, dark; limb reflexed, elliptic, obtuse, pubescent outside with ± appressed hairs. *Anthers* elliptic, ± 1 mm long; filaments short, thick. *Hypogynous scales* broadly oblong, ± truncate but 1–3-lobed, 1 mm long. *Pistil* 28–38 mm long, gently curved, then strongly bent below apex, ± quadrangular below pollen-presenter, glabrous; pollen-presenter narrowly ovoid, obtuse, ± 0·7 mm long; stigmatic groove obliquely terminal; ovary ± 0·7 mm long, glabrous. *Infructescence* ± spherical, 4–7 cm diam., the old flowers persistent but mostly squeezed out except at base of cone; bracts not much enlarged, concealed. *Follicles* in plan view ± elliptic to rounded-rhomboidal but sometimes distorted, 10–25 mm long, up to 6 mm high, 8–22 mm wide (usually of similar size in each cone), tightly packed, much flattened or rounded; ridge obtuse; suture very fine; valves shortly pubescent with spreading or appressed hairs becoming glabrous and slightly rugose on exposed parts, green and viscid when young, turning yellowish-brown or dark grey; follicles opening with fire to 9 mm, slightly recurved; lips ± 0·5 mm. *Seed* ± cuneate, 20–25 mm long; seed body falcate, 12–18 mm long, 2–2·5 mm wide, ± obtuse at base, the apex produced to narrow beak at stylar point, inner surface ± flat with ridge along stylar margin, mottled dark grey, outer surface flat, slightly wrinkled, brownish grey; wing 11–17 mm wide, ± flattened at apex, decurrent almost to base of seed body on side opposite style, mottled dark brown. *Separator* similar to seed in shape and size, dark brown.

Distribution. (Fig. 102) South West Western Australia: widespread in southern regions between Corrigin, Woodanilling, the Barrens, Forrestania, and eastwards near the coast to Esperance.

Selected collections. SE of Corrigin in 32°31′S, 117°58′E, 6 Sept. 1976, *A. S. George* 14362 (PERTH); 16 miles (25 km) W of Lake Grace, 11 Nov. 1931, *W. E. Blackall* 1317 (PERTH); ± 13·5 km W of Woodanilling, 27 Sept. 1977, *A. S. George* 14926 (PERTH); 4 miles (6 km) W of Forrestania crossroads, 10 Dec. 1964, *F. Lullfitz* 4021 (PERTH); 21 miles (33 km) E of Ravensthorpe, 26 Jan. 1964, *A. S. George* 6089 (PERTH); E Mt. Barren, 29 Aug. 1962, *C. A. Gardner* 14033 (PERTH); Gibson, Jan. 1963, *C. F. Davies* 151 (PERTH).

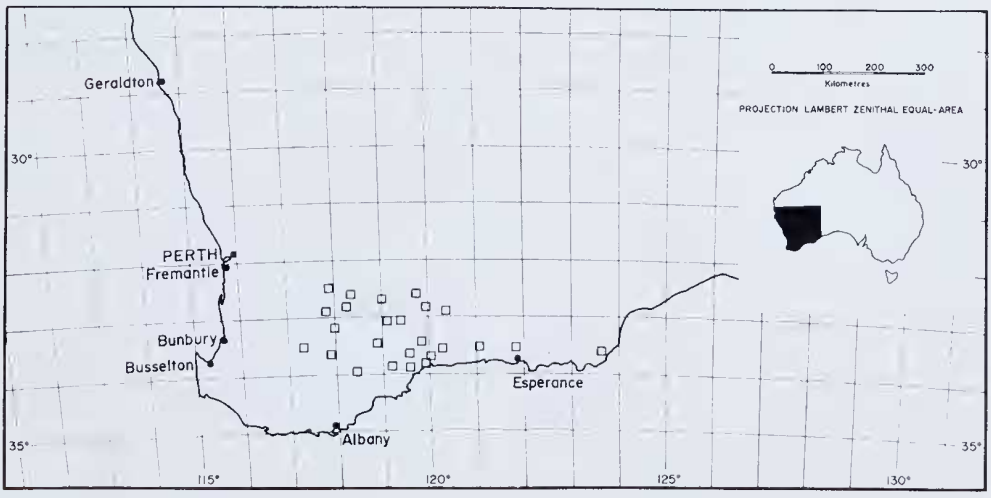


Figure 102. Distribution of *Banksia violacea*.

Habitat. In white sand or sandy loam over laterite, clay or quartzite, in open-heath, low shrubland or tall open shrubland with mallee *Eucalyptus;* sometimes sympatric with *B. sphaerocarpa* var. *caesia.*

Flowering period. November to February, a few flowers as late as May or as early as October.

Banksia violacea may be recognised by its short usually obtuse leaves, its purple or purple and green flowers and its flattened, closely pubescent follicles (viscid when young) with persistent old flowers. It shows the usual variation of *Banksia* species in size of leaves, flowers and fruit but generally is consistent in its features. The most interesting variants are several populations in the north-western part of the species' range, e.g. George 14434, 14926, 15268. While the species typically has no lignotuber, plants of these populations apparently do have them, though they have not been seen in post-fire situations. This is the only taxon in the *Abietinae* in which both states occur. Throughout the genus, in fact, the presence or absence of a lignotuber or fire-resistant stems is usually consistent within a taxon. The only other species which varies in this respect is the very polymorphic *B. marginata* Cav.

67. Banksia meisneri Lehm.

Pl. Preiss. 1: 582 (3–5 Nov. 1845)—*Sirmuellera meisneri* (Lehm.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In planitie arenosa prima cis flum. Gordon, Hay, m. Oct. 1840. Herb. Preiss. No. 488". From several isotypes I have selected as lectotype a sheet at LD bearing a Preiss label "Frutex 2-3-pedalis. In planitie arenosa prima cis fluvium "Gordon" (Hay) Scm. num. 382 Octbr. 40. L. Preiss legit" and the number 488. Iso: B, L, MEL. The specimens are in old flower.

Cotyledons (Fig. 9.62) narrowly obovate, 10–12 mm long, 4–5 mm wide, ± nerveless, medium green; auricles spreading, acute, 2 mm long. *Hypocotyl* 2·5–3·5 cm long, slender, glabrous, green. *Seedling leaves* crowded, the first few in ± opposite pairs close above cotyledons, spreading, linear, obtuse, 7–11 mm long, hirsute above including a terminal tuft of long hairs, white-woolly below, margins loosely revolute; higher leaves similar but more closely revolute, acute, those of var. *meisneri* remaining widely spreading or reflexed, ± 1·5 mm wide, those of var. *ascendens* spreading, then erect, much narrower (± 0·5 mm) with margins more revolute than in var. *meisneri*; seedling stem hirsute with straight hairs and pubescent with short curled hairs, some ± persistent; lateral branches soon developing above cotyledons.

Mature plant a shrub to 2 m with a single basal stem and much branched above; no lignotuber. *Branchlets* tomentose with short crisped and long spreading hairs, some persistent for 2–3 years; a few subulate, tomentose prophylls for up to 1 cm from base, ± deciduous. *Leaves* scattered, ± reflexed from the top of the petiole or erect, linear-elliptic to linear, shortly mucronate with a slightly upturned mucro, 3–15 mm long including a petiole of 0·5–1 mm, 1–1·5 mm broad, margins revolute, often almost touching, the midrib depressed on lower side; lamina hirsute above when young with spreading hairs, becoming glabrous except the margins; midrib below also hirsute. *Inflorescence* on lateral branchlet, occasionally terminal, the branchlets leafy to within 1 cm or so of inflorescence where there are subulate involucral bracts 2–3 cm long, becoming more numerous and forming the involucre around base of inflorescence. *Axis* 2–3 cm long, 2–3 mm wide, 9–11 mm wide including common bracts. *Common bracts* broadly linear, 3·5–4 mm long, densely hirsute with straight, pale ferruginous hairs; exserted apex ± conical, obtuse, upturned, tomentose with pale hairs. *Floral bracts* similar but slightly shorter and narrower. *Flowers* golden-brown; styles yellow. *Perianth* 7–9 mm long including limb of 1·5 mm; claws filiform, ± 0·3 mm wide, densely hirsute outside with short and long curled hairs, glabrous inside; limb elliptic, obtuse to almost acute, glabrous. *Anthers* ± 0·9 mm long. *Hypogynous scales* oblong, obtuse, irregularly lobed, ± 0·8 mm long. *Pistil* 20 mm long, recurved below apex, glabrous; pollen-presenter funnel-shaped, 0·3–0·4 mm long and broad, the apex flattened-convex, margins on opposite sides produced into small lobes with a vertical flange between them on one side, along

the edge of which is the stigmatic groove; ovary 0·5 mm, glabrous or with straight hairs about apex. *Infructescence* spherical, sometimes vertically compressed, 3–5 cm long, 4–5 cm diam., old flowers persistent for 1–2 years and the flower bases thereafter also; bracts enlarged and indurated but loosely packed, dark brown. *Follicles* 12–22 mm long, 1–7 mm high, 3–4 mm wide; ridge obtuse; suture narrow, rather undulate; valves semi-elliptic, densely tomentose with pale brown curled hairs, exposed parts becoming glabrous; follicles opening with fire to 10 mm, the valves somewhat recurved; lips ± 0·8 mm wide. *Seed* broadly obovate, 20–24 mm long; seed body oblong to narrowly obovate with apex turned to stylar side and beaked, 8–10 mm long, 2–3 mm wide, obtuse at base; outer face slightly convex, grey-brown, inner face ± flat, black; wing 19–23 mm wide, more expanded on stylar side, the other side decurrent half-way down seed body, streaked/mottled brown and pale brown. *Separator* similar to seed in shape and size, the wings much recurved when dry, streaked dark and pale brown.

Banksia meisneri may be easily recognised by its short, dark green, reflexed or erect leaves, its small flowers, turbinate pollen-presenter, and its loosely packed infructescences with rather narrow follicles. It is closely related to *B. pulchella* R.Br. which is also non-lignotuberous and small-flowered with a similar pollen-presenter, but which has a more open habit, longer and thicker ± glaucous leaves, and smaller infructescences which are more tightly packed with small grey follicles and the old flowers deciduous. The loose packing of the follicles and bracts does not occur in any other species. The perianth is shorter in this species and *B. pulchella* than in all other *Banksias*.

There are two varieties, differentiated solely on the basis of the leaves. The difference is consistent, however, being present from the seedling stage, and gives each a distinctive aspect. The habit is similar for each variety but the geographical ranges are disjunct. Both varieties are floriferous.

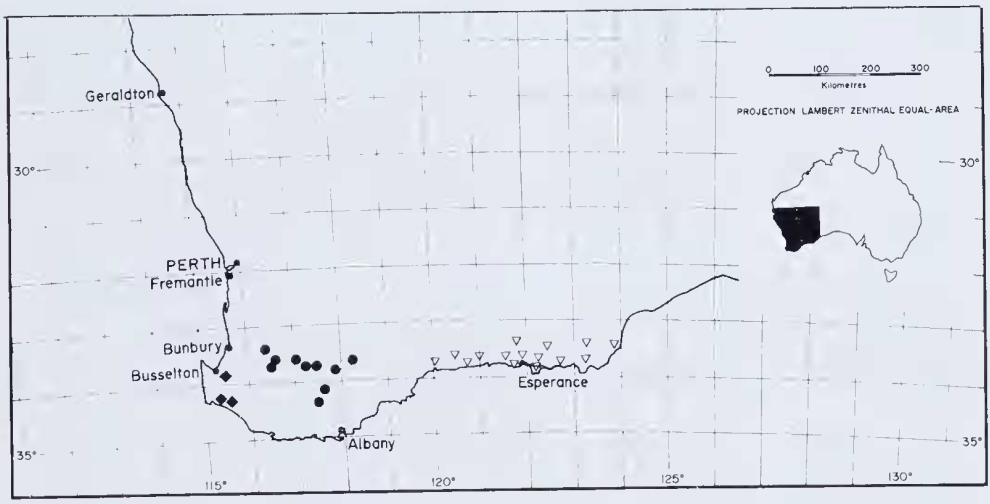


Figure 103. Distribution of *B. meisneri* var. *meisneri* (●), *B. meisneri* var. *ascendens* (◆) and *B. pulchella* (▽).

67A. Banksia meisneri Lehm. var. **meisneri**

Leaves reflexed, sometimes spreading, 3–7 mm long.

Distribution. (Fig. 103) South West Western Australia, between Collie, Pingrup and Tenterden.

Selected collections. Muja, E of Collie, 8 April 1922, *C. A. Gardner* 1314 (PERTH); Near Haddleton Springs, between Boyup Brook and Darkan, 3 Oct. 1971, *A. S. George* s.n. (PERTH); Pingrup, 24 Oct, 1933. *W. E. Blackall* 3095 (PERTH); Tenterden, May 1965, *H. E. Daniels* s.n. (PERTH).

Habitat. In deep white sand on low-lying, sometimes swampy flats, usually in low or tall shrubland, e.g. with *Kunzea ericifolia.*

Flowering period. Late April to August, with a few flowers into October.

The short, reflexed leaves of var. *meisneri* are unique in the genus. The variety is widespread but most of its known populations are small and it cannot be considered common. Being killed by fire, both varieties are vulnerable to frequent burning.

67B. Banksia meisneri Lehm. var. **ascendens** A. S. George, var. nov.

Folia ascendentia, interdum patentia, 8–15 mm longa.

Type: S of Tutunup (east of Busselton) Western Australia, 26 June 1973, *A. S. George* 11659. Holo: PERTH; iso: CANB, K, NSW, PERTH.

Leaves ascending, sometimes spreading, 8–15 mm long.

Derivation of name. From the Latin *ascendens*, ascending, in reference to the leaves.

Distribution. (Fig. 103) South West Western Australia: near Busselton and on the Scott River plains.

Selected collections. Scott River plains, E of Augusta, 24 Oct. 1948, *R. D. Royce* 2973 (PERTH); Tutunup, 20 April 1969, *E. Wittwer* s.n. (PERTH); E end of Scott River plains, 20 April 1976, *H. Dempster* s.n. (PERTH); Swan River colony, *J. Drummond* 2:338 (BM, G, K, L, MEL).

Habitat. Deep white or grey sand, on or near swamp flats, in open-heath and low shrubland, sometimes in low open-woodland with *Banksia ilicifolia.*

Flowering period. Late April to August.

Although this taxon differs from var. *meisneri* only in the erect, longer leaves, the character is consistent and gives it a different aspect. The two varieties occupy similar habitats in the South West but they are nowhere sympatric. The var. *ascendens* is the only taxon of the series *Abietinae* found in the extreme South West. It is known from only a few localities in areas mostly cleared for agriculture.

68. Banksia pulchella R.Br.

Trans. Linn. Soc. London 10: 202 (Feb. 1810)—*Sirmuellera pulchella* (R.Br.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land; in ericetis aridis prope littora. (ubi v.v.)". Lecto (here chosen): BM—a sheet labelled by Brown "I Banksia pulchella pr. 391 desc, ic. D. Bauer Ericeta prope littora sinus Bay I ora australi". Bay I is Lucky Bay, just east of Esperance. Iso: BM, K.

Cotyledons (Fig. 9.63) narrowly obovate, slightly curved, 9–10 mm long, 3–4 mm wide, spreading, dull green; auricles vertical, 1·5 mm long, acute. *Hypocotyl* slender, glabrous, reddish. *Seedling leaves* opposite for 3 pairs then scattered, and ± crowded, the first pair 3–4 mm long, loosely revolute, hirsute above becoming glabrous, white-tomentose below; upper leaves linear, obtuse, 8–15 mm long, tightly revolute, indumentum as in first leaves. *Seedling stem* sparsely hirsute becoming glabrous; lateral branches often forming in axils of cotyledons within a year.

Mature plant a shrub to 1 m tall without lignotuber. *Basal stem* single, openly branched above. *Bark* ± smooth, grey. *Branchlets* when very young sparsely hirsute with long straight hairs which are soon deciduous except a few around petioles; a few linear obtuse prophylls near the base, the remainder leafy. *Leaves* scattered, linear, straight or slightly incurved, erect, obtuse, 4–13 mm long including petiole of 1–1·5 mm, ± 1 mm wide; margins closely revolute; midrib sunken on lower surface, flat or slightly concave; lamina when very young sparsely hirsute, soon glabrous except the white wool of the lower surface. *Inflorescence* terminal usually on lateral leafy branchlet, cylindrical, 20–25 mm wide just before anthesis, 35–50 mm with styles expanded. *Axis* 20–25 mm long, 2–3 mm wide, 5–7 mm wide including common bracts. *Involucral bracts* spread over 2–3 mm of branch, subulate from thick bases, 2–3 mm long, inner surface and outside margins toment-

ose with short, curled hairs, occasionally throughout. *Common bracts* narrowly cuneate to linear, 2–2·5 mm long, thick, densely hirsute with ferruginous hairs; exserted apex conical, slightly upturned, with shorter curled grey hairs and a few long straight ones. *Floral bracts* similar but shorter, narrower and the apices scarcely exserted. *Flowers* golden-brown; styles bright yellow. *Perianth* 8–10 mm long including limb of 1–1·5 mm; claws filiform, 0·1–0·2 mm wide and gradually narrowed upwards, densely hirsute outside with long and short spreading hairs, glabrous inside; limb reflexed, elliptic but slightly broader in lower third, ± obtuse, glabrous, the margins pale. *Anthers* elliptic but broader in lower third, 0·5 mm long on short filaments. *Hypogynous scales* linear-oblong, obtuse, sometimes shortly lobed, 0·5–1 mm long, free from each other but cohering at base to perianth. *Pistil* 17–24 mm long, thickened above ovary then tapering, glabrous, the apex recurved; pollen-presenter turbinate-globular, 0·2 mm long, apex flat to conical; stigmatic groove terminal; ovary 0·5 mm long, glabrous. *Infructescence* spherical, ovoid or obovoid, often irregular, 3–5 cm long, 3–4 cm wide, grey; old perianths and styles early deciduous; bracts enlarged and indurated, the apices flat to convex, irregularly elliptic or angular, tomentose but exposed areas becoming glabrous and smooth. *Follicles* 8–17 mm long, up to 3 mm high, up to 7 mm wide, often scarcely exposed; valves semi-elliptic, hirsute with spreading hairs, the exposed parts becoming glabrous; suture fine, ± undulate; follicles opening with fire to 7 mm, the valves not or scarcely recurving; lips ± 0·5 mm wide, dark brown. *Seed* 12–20 mm long; seed body narrowly cuneate to oblong, 7–11 mm long, 2–3·5 mm wide, base acute or obtuse, upper margin ± oblique with stylar side the longer and ± straight, opposite side convex, black inside, brown outside; wing cuneate, extending down side opposite stylar point, inside dark brownish black and dull, outside dark grey-brown and smooth. *Separator* similar to seed in shape and size, brown.

Distribution. (Fig. 103) South West Western Australia: between Culham Inlet and Israelite Bay, extending up to 40 km inland.

Selected collections. 1·5 miles (2 km) N of Hopetoun, 24 May 1959, *A. S. George* s.n. (PERTH); 19 miles (31 km) E of Ravensthorpe, 15 March 1957, *J. W. Green* 1227 (PERTH); Near Esperance, 22 May 1924, *C. A. Gardner* 1714 (PERTH); 20 miles (32 km) N of Gibson, 10 August 1951, *R. D. Royce* 3559 (PERTH); Cape le Grand, 2 Sept. 1962, *C. A. Gardner* 14129 (PERTH); 30 km W of Mt. Ragged, 10 Sept. 1964, *P. G. Wilson* 2950 (AD, PERTH); Israelite Bay, Oct. 1931, *C. A. Gardner* s.n. (PERTH).

Habitat. In deep white sand, in tall shrubland, open-shrubland and open-heath, often associated with *Banksia speciosa* and *Lambertia inermis.*

Flowering period. Flowers have been recorded at all times of the year; the peak flowering is in summer and early winter.

Banksia pulchella is closely related to *B. meisneri* Lehm. but can be distinguished by the more open habit; the thicker, longer, erect grey-green leaves, and the smaller follicles in a tightly packed infructescence. The perianth in these two species is smaller than in any other *Banksia*. The turbinate pollen-presenter is also confined to them, being of different form from that of *B. aemula* R.Br. The species is morphologically uniform.

69. Banksia nutans R.Br. (Figures 104 and 105)

Trans. Linn. Soc. London 10:203 (Feb. 1810)—*Sirmuellera nutans* (R.Br) Kuntze, Rev. Gen. Pl. 2: 582 (1901).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land: in ericetis aridis prope littora. (ubi v.v.)". Lecto (here chosen): BM, with 2 Brown labels—"Barren Hills and on Heaths near Bay No. 1, South Coast New Holland, Jany 1802" and "3 Banksia nutans prodr. 391 Ericeta ora australi Bay 1 Jany 1802". Iso: BM, FI, K, P.

Cotyledons (Figs. 9.64, 9.65) obovate with upper margin oblique, spreading, 11–12 mm long, 6–10 mm wide, faintly reticulate, medium to bright green with red-maroon margins; auricles descending, acute, 1·5–2·5 mm long. *Hypocotyl* 15–35 mm long, slender, red, hirsute (var. *nutans*) or glabrous (var. *cernuella*). *Seedling leaves* crowded; first two or three close above cotyledons, linear to very narrowly cuneate, obtuse, sometimes bilobed, 6–8 mm long, sparsely hirsute above, loosely woolly below, the margins recurved to revolute; higher leaves narrowly linear, entire, to 20 mm long, acute, otherwise similar. *Seedling stem* sparsely hirsute, becoming glabrous.

Mature plant a shrub to 1·3 m tall, 1–2 m wide, without lignotuber, single-stemmed at base, much-branched above and usually dense. *Branchlets* glabrous excepting a few curled hairs in the axils, with several subulate prophylls near the base, densely-leaved above especially at apex; older branches with the bark peeling in thin, irregular, reddish or grey and brown flakes. *Leaves* scattered, spreading or erect, linear, straight or curved, acute to pungent, 10–28 mm long, 0·5–1·25 mm wide, the petiole 2–3 mm long; margins closely revolute, often almost touching and concealing the sunken midrib; upper surface glabrous excepting a few straight hairs when very young, the lower surface white-woolly; foliage often with blue tinge. *Inflorescence* terminating a lateral leafy branchlet or on a short peduncle on an older stem, mostly somewhat concealed within shrub, pendent; stem below inflorescence with many bracts passing into the involucre. *Axis* 4–7 cm long, 3–5 mm wide, 10–14 mm wide with common bracts, bearing flowers almost to base; floral development acropetal. *Involucral bracts* subulate from broad bases, lower ones 2–3 mm long and pubescent, upper ones to 4 mm long and pubescent only at base and apex, otherwise glabrous. *Common bracts* linear, 4–5 mm long, thick, densely hirsute with ferruginous hairs shorter apically; exposed apex expanded, flattened, ± wrinkled, glabrous, when fresh bright green, or reddish-purple when exposed to light. *Floral bracts* similar but narrower and with smaller apices. *Flowers* pinkish purple in bud, purplish-brown at anthesis; strongly onion-scented; styles cream. *Perianth* 22–29 mm long, including limb of 2·5–3·5 mm, ± straight but limb abruptly reflexed; claws filiform, 0·2 mm wide, appressed-pubescent outside, and inside along margins which often adhere for 3/4 of length; limb narrowly elliptic-oblong, almost acute, shortly appressed-pubescent at base, the apex glabrous. *Anthers* elliptic, ± 1 mm long, filaments 1 mm long. *Hypogynous scales* narrowly linear, almost acute, entire, 2 mm long, free from each other, adhering to perianth at base. *Pistil* 22–36 mm long (20–33 mm to bend), strongly recurved below apex, glabrous; pollen-presenter ovoid or narrow, ± 1 mm long, mostly dark red-brown; stigmatic groove lateral to apex; ovary ± 1 mm long, glabrous or shortly pubescent. *Infructescence* spherical-oblong, 6–10 cm long, 6–8 cm wide; old perianths and styles persistent but often squeezed out or obscured by the massive follicles. *Follicles* much enlarged, broadly oblong to narrowly elliptic in plan view, 18–40 mm long, 8–15 mm

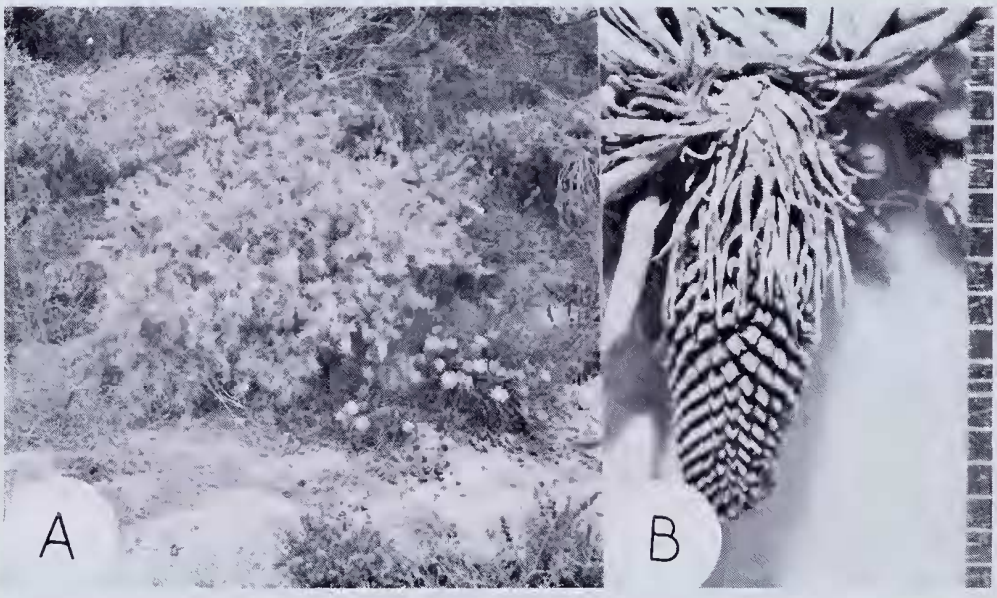


Figure 104. *Banksia nutans* var. *cernuella*. A—Habit, ± 50 cm tall (W of Woodanilling, W.A.). B—Young inflorescence, showing involucral bracts and common bracts (Scale in mm.)

Figure 105. *Banksia nutans.* Infructescences—all x $\frac{3}{4}$. Top—*B. nutans* var. *nutans.* (Left—Typical form, drawn from A. S. George s.n., Esperance; Right—follicles flanged, less rugose, drawn from A. S. George 15091). Below—*B. nutans* var. *cernuella.* (Drawn from A. S. George 15093).

high, 8–38 mm wide, ± flattened on top; valves broad and thick, often laterally flanged, usually very rugose or wrinkled except on each side of the very narrow suture where ± smooth, green when young becoming pale brown or grey, loosely and shortly hirsute becoming glabrous: in western populations the valves less wrinkled but the lateral flange more angular; follicles opening with fire very narrowly, to 2–4 mm, not recurved. *Seeds* cuneate to broadly obovate, 15–27 mm long; seed body 7–12 mm long, 4–7 mm wide, almost semi-orbicular but very oblique; stylar margin ± straight, the other very convex, base obtuse; inner surface smooth, shining, brown; outer surface dull, pale brown, ± mottled; wing 15–25 mm wide, fairly evenly expanded, decurrent down side of seed body opposite style, scarious, dark brown outside with golden-brown centre, mottled; pale brown inside, not mottled. *Separator* similar to seed in shape and size, rather thin, lower half pale brown, upper dark dull brown, inner surface shining; upper margin of wings ± undulate.

Banksia nutans is a distinctive member of *Abietinae*, recognised by its crowded, bluish-green short leaves, its pendulous inflorescence with acropetal development and its flat-topped, rugose to slightly rugose follicles. The onion-like scent of the flowers is unique to the species. There are two varieties, distinguished by the size of the follicles and to a lesser extent the size of the flowers.

69A. Banksia nutans R.Br. var. **nutans** (Figure 105)

Perianth 25–33 mm long; limb 3–3·5 mm long. *Pistil* 28–36 mm long. *Follicles* 25–40 mm long, 10–15 mm high, 15–38 mm wide, flattened on top, often laterally flanged, usually very rugose, sometimes slightly so.

Distribution. (Fig. 107) South West Western Australia, from the east side of the Pallinup River to Israelite Bay, within 30 km of the coast.

Selected collections. 30 miles (48 km) W of Bremer Bay, 27 Oct. 1965, *A. S. George* 6914 (PERTH); S end of Middle Mt. Barren, 27 Jan. 1976, *A. M. George* 22 (PERTH); Dalyup, W of Esperance, Jan. 1935, *C. A. Gardner* s.n. (PERTH); 3 km WSW of Israelite Bay ruins, 7 Jan. 1979, *B. Barnsley* 347 (CBG, PERTH).

Habitat. In deep white or grey sand, sometimes over gravel, or on coastal consolidated dunes, in tall shrubland, tall open shrubland and open scrub.

Flowering period. November to February.

Banksia nutans var. *nutans* is fairly uniform in habit and inflorescence but variable in leaves and follicles. The leaves are usually fine and crowded but in a few collections are more widely spaced, spreading and 1·5 mm broad, e.g. Duke of Orleans Bay, 2 Oct. 1968, A. E. Orchard 1324 (AD, PERTH). The follicles are typically very rugose, and rounded at the edges, but in western populations they are often only slightly rugose and the edges are rather narrow, sometimes overhanging. When burnt the follicles open very narrowly.

69B. Banksia nutans R.Br. var. **cernuella** A. S. George, var. nov. (Figures 105 and 106)

Perianthium 22–24 mm longum limbo 2·5–3 mm longo includens. *Pistillum* 22–25 mm longum. *Folliculi* 18–30 mm longi, 8–12 mm alti, 8–15 mm lati, supra ± complanati sed convexi, parum rugosi vel corrugati.

Type: SW of Pallinup River on Hassel Hwy., Western Australia, 28 Jan. 1978, *A. S. George* 15092. Holo: PERTH; iso: CANB, K.

Perianth 22–24 mm long, including limb 2·5–3 mm long. *Pistil* 22–25 mm long. *Follicles* 18–30 mm long, 8–12 mm high, 8–15 mm wide, ± flattened but convex on top, flanged, slightly rugose or wrinkled.

Derivation of name. From the Latin *cernuus*, nodding, with the diminutive suffix—*ella*, in reference to the pendulous inflorescence and infructescence with smaller flowers and follicles.

Distribution. (Fig. 107) South West Western Australia, chiefly from the Stirling Range to Albany and east almost to the Pallinup River, with an outlier near Woodanilling.

Figure 106. *Banksia nutans* var. *cernuella*. Holotype, A. S. George 15092 (PERTH).

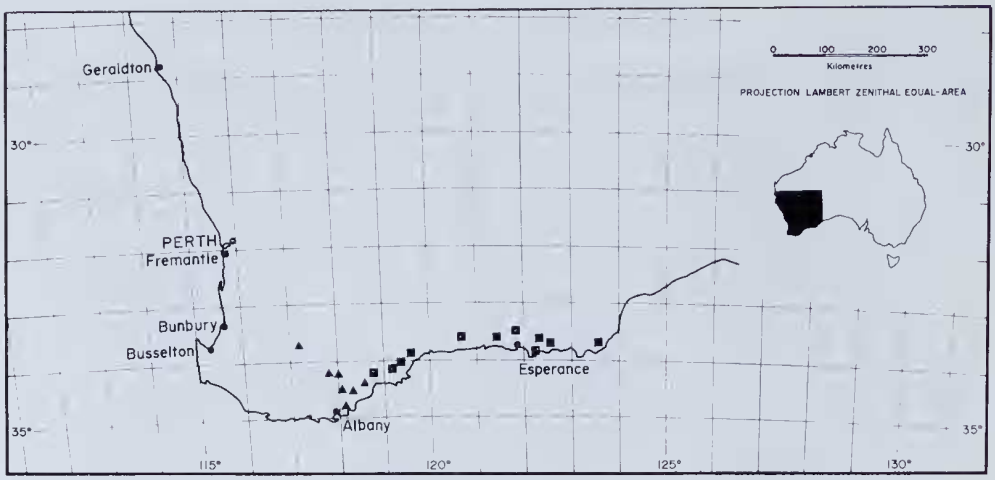


Figure 107. Distribution of *Banksia nutans* var. *nutans* (■) and *B. nutans* var. *cernuella* (▲).

Selected collections. W of Woodanilling, 29 Jan. 1978, *A. S. George* 15093 (AD, BRI, CANB, K, MEL, NSW, NT, PERTH); Chester Pass, Stirling Ra., 2 July 1957, *A. R. Main* s.n. (PERTH); South Stirling road, E of Chester Pass road, 28 Jan. 1978. *A. S. George* 15087 (CANB, PERTH); Gull Rock road, E of Albany, 15 Jan. 1980, *A. S. George* 15799 (PERTH).

Habitat. In deep white or grey sand, often in depressions, in tall shrubland and in low open-woodland, e.g. with *Eucalyptus occidentalis*, *Banksia attenuata* and *Lambertia inermis*.

Flowering period. Late January to early April.

The variety *cernuella* differs from var. *nutans* chiefly in its smaller flowers and much smaller, less rugose follicles. Flowering is generally later, but there is some overlap between the varieties. The distributions are disjunct, but only a short distance separates the eastern limit of var. *cernuella* and the western limit of var. *nutans*, the valley of the Pallinup River lying between them. The var. *nutans* always has much larger follicles than var. *cernuella*, but in western collections they are often less rugose than is typical and sometimes approach var. *cernuella* in this respect. Both varieties have the same bushy habit and curious flaky bark, though var. *cernuella* is often more open and slender with greener foliage.

Banksia nutans var. *cernuella* is fairly uniform thoughout its range except for the population west of Woodanilling in which the leaves are longer and more slender than is typical (George 14916).

Subgenus **Isostylis** R.Br.

Prodr. 396 (1810).

Section *Isostylis* (R.Br.) Meissner in DC. Prodr. 14:466 (1856).

Inflorescence short and head-like: receptacle ovoid, less than 1 cm long. *Perianths* not tightly packed. *Pistil* straight, slender. *Follicles* obliquely ovoid.

Type species (by monotypy): *Banksia ilicifolia* R.Br.

The subgenus *Isostylis* contains only two closely related species, *B. ilicifolia* R.Br. and *B. cuneata* A. S. George. Both are endemic in South West Western Australia, the latter being known from only four small populations and therefore considered endangered. The superficial resemblance to *Dryandra* has prompted the suggestion that the two species

be transferred to that genus, but the step has never been formally taken. They in fact belong less to *Dryandra* than to *Banksia* and if any change were to be made it should be to place them in their own genus. I retain them in *Banksia* for the following reasons:

1. the inflorescence has an ovoid axis and in this respect is similar to *Banksia elegans;* in *Dryandra* there is a flat receptacle;
2. the involucral bracts are typical of *Banksia*—broadly based with narrow, terete apices; in *Dryandra* the bracts are not broadly based and their laminae are usually flat;
3. the common and floral bracts are typical of *Banksia*;
4. the follicle is thick, woody and tomentose and again is similar to that of *B. elegans*: its method of opening is similar to that of many species of *Banksia*. In *Dryandra* the follicle though woody is rather thin and is glabrous;
5. the first seedling leaves are very like those of *B. coccinea*.

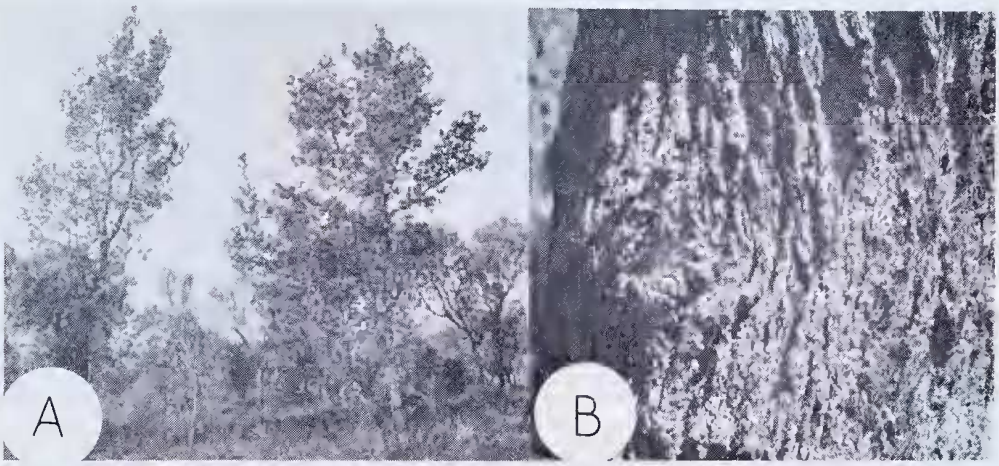


Figure 108. *Banksia ilicifolia*. A—Habit, 9–10 m tall. B—Bark. (Both Jandakot, W.A.).

70. Banksia ilicifolia R.Br. (Figure 108)

Trans. Linn. Soc. London 10: 211 (1810)—*Sirmuellera ilicifolia* (R.Br.), Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Type citation: "In Novae Hollandiae orâ australi; Lewins Land in campis collibusque prope littora (ubi v.v.)". I have selected as lectotype one of two Robert Brown sheets at BM, labelled by him "31 Banksia ilicifolia prodr. 396 Colles saxosi aprici prope Portum Regis Georgis IIItii in oro australiae Novae Hollandiae Dec 1801". Iso: BM, K.

B. aquifolia Hort. ex Dum.-Cours., Bot. Cult., ed.2, 7: 108 (1814). Nomen nudum, in synonymy under *B. ilicifolia* R.Br.

Banksia aquifolium Lindley, Sketch Veg. Swan Riv. Col. 34 (1840). *Type citation:* none given. The collections described in this work were mostly made by James Drummond on his early explorations in Western Australia. Lecto (here chosen): a sheet at CGE collected at Swan River in 1839 by James Drummond and annotated by Lindley "Banksia (Isostylis) Aquifolium m.

Banksia ilicifolia R.Br. var. *integrifolia* Benth., Fl. Austral. 5: 562 (1870). *Type citation:* "Swan river, Preiss, n. 482 (some specimens)". Meissner in Lehmann (1845) gave the locality for this collection as "In arenosis prope oppidum Perth, d. 13 Apr. 1839". Lecto (here chosen): MEL; iso: B, LD, MEL. None of the sheets was annotated by Bentham.

Cotyledons transversely elliptic, 8–13 mm long, 12–18 mm wide, ± horizontal, convex to concave, ± nerveless, dull green; auricles spreading, acute, 1·5 mm long. *Hypocotyl* short, thick, glabrous, green. *Seedling leaves* crowded above cotyledons, in outline narrowly obovate to broadly lanceolate, deeply lobed; lobes narrowly triangular to oblong, slightly curved forwards, abruptly narrowed to acute apex, the basal and apical lobes 1–3

mm long, others up to 1·5 cm long; first leaves 1–2·5 cm long, ± 1 cm wide, with 3–4 lobes on each side; sinus narrowly U- to V-shaped; upper surface loosely hirsute with spreading, straight hairs; lower surface long-hirsute with spreading, straight hairs; lower surface long-hirsute with straight hairs on nerves, otherwise densely woolly with curled hairs; margins somewhat recurved. *Seedling stem* hirsute. *Juvenile leaves* narrowly obovate, obtuse to truncate but mucronate, 4–10 cm long, 1·5–3·5 cm wide, deeply lobed, the lobes ± triangular; distal side shorter and usually curved, 5–14 mm long; proximal side often curved, 5–20 mm long, the apical and basal lobes smaller; narrowed to petiole; indumentum as in other leaves.

Mature plant a tree to 10 m. *Trunk* stout, up to 50 cm diam.; bark up to 2 cm thick, finely to roughly fissured-tessellated, very fibrous, grey. *Branchlets* at first 2–3 mm thick, loosely hirsute with straight, spreading hairs and closely tomentose with curled hairs, becoming glabrous after 2–3 years. *Leaves* mostly on branchlets less than 2 years old, scattered, but more crowded towards apices; obovate-elliptic, undulate, obtuse to truncate but pungently mucronate, 3–10 cm long including petiole of 3–10 mm; margins usually serrate with up to 14 teeth on each side, usually entire in proximal 1/4–1/2, sometimes entire throughout or with few teeth; teeth ± triangular, distal edge straight to gently sigmoid, 2–6 mm long; apices pungently mucronate, the mucro erect or turned slightly upwards; sinus broadly V- to U-shaped; upper surface of lamina when young loosely hirsute with spreading hairs and closely tomentose with curled hairs, becoming glabrous and shining; lower surface hirsute with spreading hairs on nerves, tomentose throughout with curled hairs, becoming glabrous except in the very small lacunae; nerves at 60°–70° to axis, only those to teeth and sinuses evident, finely reticulate between. *Inflorescence* head-like, terminating a leafy branchlet usually 1 year old, not subtended by lateral branchlets; development centripetal. *Axis* ovoid-globose, 4–6 mm long, 3–5 mm wide, 9–11 mm wide with common bracts, bearing flowers all over. *Involucral bracts* linear-fusiform, obtuse, thick, 2–5 mm long, densely tomentose-pubescent with grey or pale ferruginous hairs; bracts persistent through flowering. *Common bracts* linear, 3 mm long, densely pale-hirsute; exserted apex obtuse, rounded, tomentose. *Floral bracts* similar. *Flowers* white at base, then deep pink for up to 6 mm, then cream, becoming dull red throughout; styles cream, pollen-presenter green. *Perianth* 32–40 mm long including limb of 2·5–4 mm, straight or the outer ones curved at base; tube slightly swollen above base, splitting above along adaxial side, and recurving abaxially, distal part splitting into 4 lobes; claws 0·3–0·4 mm wide, shortly appressed-pubescent outside, glabrous inside; limb fusiform, swollen at base, obtuse, glabrous, without prominent nerves. *Anthers* 2 mm long on thick filaments 0·5 mm long. *Hypogynous scales* oblong, obtuse, 2 mm long. *Pistil* 2·7–3·5 cm long, straight, or slightly curved above base, thickened above ovary and 1 mm thick, then tapered, glabrous except a few short appressed hairs above ovary; pollen-presenter straight, scarcely thickened, 1–1·5 mm long, ± oblong, obtuse, stigmatic groove set between 2 flaps oblique at apex; ovary glabrous. *Infructescence* small, of 1–3 follicles; common and floral bracts slightly enlarged, indurated. *Follicles* ± ovate but curved, 1·4–2 cm long above base, 1·3–2·4 cm high, 1–1·6 cm wide at base; usually opening after 2–3 years; perianths and styles quite deciduous; valves ± smooth, or wrinkled along suture, sometimes mottled, densely grey-tomentose but becoming glabrous with age; ridge angled; suture very fine; follicle opening to base along longer side, to 3·5 cm, on shorter side with a lateral split each side for up to 1 cm from stylar point leaving a truncate beak below; lips 2–3 mm wide. *Seed* very oblique, ± transversely elliptic, seed body transversely elliptic, often irregular, 9–12 mm wide, 5–7 mm high, the inner face convex, coarsely rugose, outer face smooth; wing terminal, not decurrent, narrowed upwards but apex rounded, 10–15 mm long, 7–10 mm wide, slightly wrinkled, black. *Separator* 2·4–2·8 cm long, 1·2–1·4 cm wide; seeds set into cavities on each side at base, the upper edge deeply concave, lower edge with short central beak; wings obliquely semi-elliptic, obtuse, on stylar side split only to stylar point; much thickened below this point, to 10–12 mm thick.

Distribution. (Fig. 109) South West Western Australia: from Mt. Lesueur south to Cape Leeuwin and east to Albany and the Stirling Range, always within 70 km of the coast.

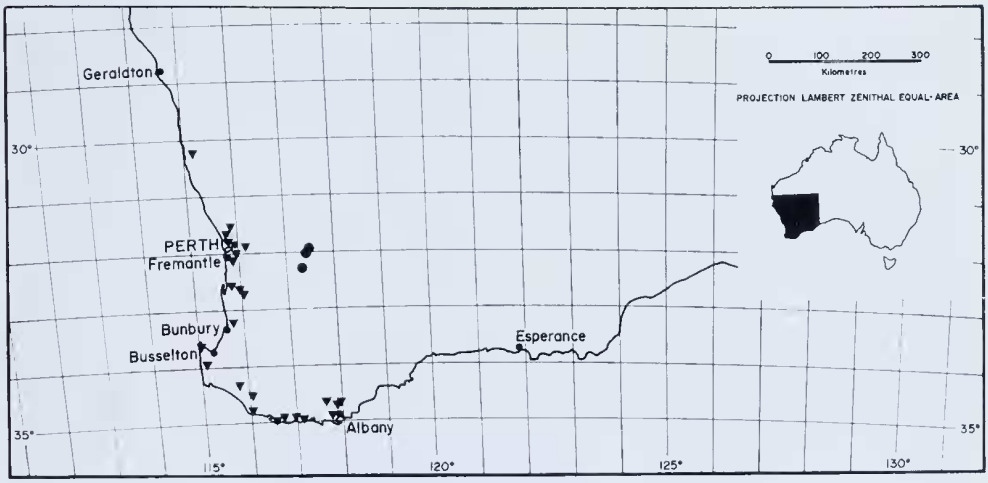


Figure 109. Distribution of *Banksia ilicifolia* (▼), and *B. cuneata* (●).

Selected collections. King George Sound (Sept-Oct 1791), *A. Menzies* (BM); S of Cockleshell Gully, 15 Nov. 1971, *A. S. George* 11201 (PERTH); Bayswater, lower Swan River, 8 Nov. 1902, *A. Morrison* s.n. (BRI, PERTH); Cape Naturaliste, *Oldfield* s.n. (MEL); 25 miles (40 km) N of Albany, 11 Dec. 1962, *F. G. Smith* 1608 (PERTH).

Habitat. In deep white or grey sand on consolidated dunes or low-lying flats, as a component of low open-woodland with such species as *Banksia attenuata*, *B. menziesii*, *Eucalyptus marginata* and *Nuytsia floribunda*; in south coastal areas, where affected by onshore winds, forming tall shrubland.

Flowering period. Recorded for all months except February, with a peak from late winter to early summer.

Banksia ilicifolia is variable in habit and morphology but not sufficiently to warrant infraspecific division. It is usually an erect tree, but in some south coastal populations it is a spreading shrub or small tree. Morphological variation appears in the size of leaves, flowers and fruit, and in the lobing of the leaves. The latter vary from entire to holly-like, but this may be seen on one plant. Although the leaves and flowers tend to be larger in southern populations they are also large in some northern trees. Neither *B. aquifolium* Lindley nor *B. ilicifolia* var. *integrifolia* Benth. can be maintained.

The species is relatively common. It is fire-resistant, with the ability to sprout from epicormic shoots. The follicles mostly open without fire to release the seed within two or three years of it maturing. From *B. cuneata* A. S. George the species can be distinguished by its larger habit, rough bark, larger leaves, flowers and fruit, and by its flower colours.

71. Banksia cuneata A. S. George, sp. nov. (Figures 110 and 111)

A *B. ilicifolia* R.Br. cortice laeve; foliis, floribus et fructibus minoribus; floribus primo caryophyllaceis deinde cremeis deinde rubescentibus, limbis viridibus, differt. Folia 1–3 cm longa; perianthium 24–25 mm longum; follicli 10–13 mm alti.

Type: E of Quairading, Western Australia, in lat. 31°59′S, long. 117°30′E, 20 Nov. 1971, *A. S. George* 11205. Holo: PERTH; iso: AD, BRI, CANB, K, MEL, NSW.

Differs from *B. ilicifolia* R.Br. in the smooth bark, the smaller leaves, flowers and fruit, and the flowers being at first pink, then cream and finally reddish, with green limb. Leaves 1–3 cm long; perianth 24–25 mm long; follicles 10–13 mm high.

Derivation of name. From the Latin *cuneatus*, cuneate, in reference to the wedge-shaped leaves.

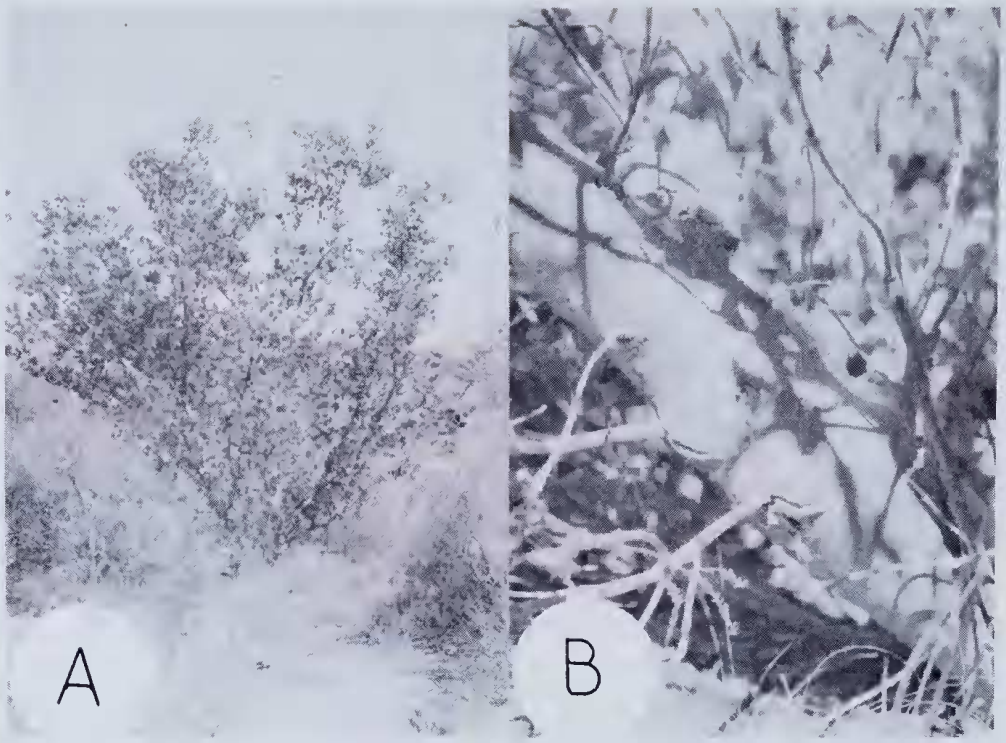


Figure 110. *Banksia cuneata*. A—Habit, ± 3 m tall. B—Bark. (Both E of Quairading, W.A.).

Cotyledons (Fig. 9·66) broadly cuneate, somewhat oblique, widely spreading, 7–8 mm long, 12 mm wide, reticulate, medium green; auricles descending, obtuse, ± 1·5 mm long. *Hypocotyl* 3–4 mm long, 1·5 mm diam., glabrous, green. *Seedling leaves* crowded immediately above cotyledons, obtuse, 15–20 mm long, 7–10 mm wide, obovate in outline but deeply divided each side into 1–3 linear to narrowly triangular obtuse lobes, the distal side the shorter, 1·5–3 mm long; margins recurved; lamina hirsute above with white hairs, more densely so at lobe apices; midrib below hirsute, the lamina white-woolly. *Seedling stem* hirsute.

Mature plant a shrub or small tree to 5 m with 1-several woody stems, without lignotuber. *Bark* smooth, grey. *Main branches* ± straight, erect; lateral branches numerous; crown becoming bushy and irregular. *Branchlets* when young hirsute with spreading hairs and pubescent with short curled hairs, becoming glabrous after 2–3 years; epidermis then deciduous to reveal brown or grey-brown bark beneath. *Leaves* cuneate to angular-obovate, obtuse or acute but mucronate, 1–4 cm long, 0·5–1·5 cm wide, sometimes smaller, usually concave; margins flat, serrate with 1–5 teeth on each side, rarely entire; teeth triangular, 1–4 mm long, mucronate; sinuses shallow and broadly V-shaped; lamina hirsute above especially on midrib with pale ferruginous spreading hairs and pubescent with short curled hairs, becoming glabrous; lower surface similar but with fine white wool persisting in lacunae; petiole tomentose. *Inflorescence* terminal, 3–4 cm diam. *Receptacle* ovoid. *Involucral bracts* ovate, acuminate, thick, 4–7 mm long, tomentose outside with grey-white curled hairs, silky-hirsute inside. *Common bracts* narrowly linear, 3–4 mm long, silky-hirsute with long ferruginous hairs; exserted apex conical, somewhat upturned, tomentose, pale brown. *Floral bracts* similar. *Flowers* cream, pink towards base, limb sometimes green; becoming pink throughout, finally pale brown; style cream becoming red; pollen-presenter green. *Perianth* 24–25 mm long including limb of 3–4 mm; claws narrowly linear to filiform, on upper side splitting to within 5–6 mm of base, otherwise cohering for most of their length, appressed-pubescent outside

Figure 111. *Banksia cuneata*. Holotype, A. S. George 11205 (PERTH).

except base, glabrous inside; limb narrowly obovate to oblong, obtuse, glabrous. *Anthers* ± 2 mm long, shortly apiculate. *Hypogynous scales* oblong, obtuse, ± 1·5 mm long. *Pistil* as long as perianth, exserted when perianth relaxes at anthesis, swollen above ovary then tapering, ± straight, glabrous; pollen-presenter ovoid, ± wrinkled, ± 1 mm long, the apex compressed, obtuse; stigmatic groove terminal; ovary narrow, 1 mm long, with a few hairs at apex. *Follicles* usually 1–5 per infructescence; perianths and styles early deciduous; follicles obliquely ovoid, 17–21 mm long, 10–13 mm high, 9–12 mm wide, obtuse, ± smooth, densely and closely tomentose with spreading and curled hairs, the former wearing off, mottled pale and dark grey; suture fine; follicle dehiscing along whole of lower side and 1/2–2/3 way along upper side; 2 lateral splits 5–7 mm long from stylar point, leaving beak below; lips ± 1 mm wide, dark brown. *Seed* obliquely ovate, 17–20 mm long; seed body obtusely and unevenly triangular, 7–8 mm wide, 4–5 mm high, very thick, black along upper inner surface with a prominent ridge, elsewhere with irregular short plate-like projections; outer surface irregularly wrinkled; wing 8–10 mm wide, ± wrinkled, with a broad, irregular sinus on stylar side. *Separator* obliquely ovate, deeply excavated next to seed body with the upper margin of cavity overhanging, much thickened above then becoming thinner on wings.

Distribution. (Fig. 109) South West Western Australia: central agricultural region between Brookton and Bruce Rock.

Selected collections. Boxvale, no date, *Miss Wells* (MEL); E of Quairading, 7 Oct. 1964, *T. E. H. Aplin* 2807a (PERTH); Near Lake Mears, 20 Nov. 1971, *A. S. George* 11208 (PERTH).

Habitat. In deep yellow or yellow-brown sand as a component of tall shrubland or low open-woodland, associated with such species as *Banksia prionotes* and *Xylomelum angustifolium.*

Flowering period. September to December.

Banksia cuneata is distinguished from *B. ilicifolia* by its smooth bark, its smaller leaves, flowers and fruit, and by its flower colours. It occurs much further inland than does *ilicifolia*, the shortest distance between their distributions being over 50 km. The follicles of *cuneata* usually remain closed until burnt, while those of *ilicifolia* often open after 2–3 years.

The species is restricted to a few populations in the central wheatbelt between Brookton and Bruce Rock. None of the populations is larger than 30–40 plants, so that the species must be considered endangered. Although no post-fire studies have been made, it appears that the plants are non-lignotuberous and hence would be vulnerable to fires at intervals too short to allow regeneration from seed and subsequent seed production. The type locality is a Nature Reserve where with correct management the species should be able to survive.

Nomina dubia in Banksia L.f.

B. asplenifolia Salisb., Prodr. 51 (1796). Insufficiently described—see discussion under 7. *B. oblongifolia* Cav.

"*B. aspleniifolia* Knight", Ind. Kew. 1:270 (1895). The reference is to the Proteeae, p. 113 (1809), where Knight was not publishing a new name but referred to *B. aspleniifolia* Salisb. (sic).

B. cuneifolia Hoffsgg., Verz. Pfl. Nachtr. 2: 64 (1826). Insufficiently described; based on cultivated material. A sheet at K bearing this name is *B. spinulosa* Smith; attributed to this species by Meissner (1856).

B. eugelii Hort. ex Jacques, Ann. de Flore et de Pomone 215 (1843). Insufficiently described.

B. floribunda J. L. Drumm., Hooker's J. Bot. Kew Gard. Misc. 1: 375 (1849). Insufficiently described; possibly *B. occidentalis* R.Br. or *B. littoralis* R.Br. var. *seminuda* A. S. George (red-styled variant).

B. grandidentata Dum.-Cours., Bot. Cult. ed. 2, 7: 108 (June 1814). Insufficiently described; based on cultivated material. Attributed to *B. speciosa* R.Br. by Steudel (1841).

B. huegelii R.Br. ex Sweet, Hort. Brit. ed. 3, p. 768 (1839), nomen nudum; also published by Endlicher, Gen. Supp. 4, 2: 89 (1847). A specimen in leaf only is at BM, labelled "Banksia huegelii" by Brown; it is probably *B. oblongifolia* Cav.

B. hypoleuca Hoffsgg., Verz. Pfl. Nachtr. 2: 66 (1826). Insufficiently described; based on cultivated material Attributed to *B. marginata* Cav. by Meissner (1856).

B. integerrima Dum.-Cours., Bot. Cult. ed. 2, 2: 421 (1811); 7: 108 (1814). Insufficiently described.

"*B. integrifolia* Schlecht.", Linnaea 20: 584 (1847), according to Index Kewensis (1895); in fact Schlechtendal cited "*B. integrifolia* L.,? var.". Attributed by Meissner (1856) to *B. marginata* Cav. (as *B. australis* R.Br.).

B. longifolia Donn ex Dietr., Vollst. Lex. Gaertn. 2: 150 (1802). Insufficiently described.

B. longifolia Hort. ex Steudel, Nom. ed. II, 1: 184 (1840); nomen nudum, pro synon. sub *B. oblongifolia* Cav.

B. marginata var. *macrostachya* Hort. Petrop.; cited by Bentham (1870) in synonymy under *B. collina* R.Br. I have found no other published reference to the name.

B. mimosoides Hort. ex Dietr., Vollst. Lex. Gaertn. 2: 150 (1802); nomen nudum, pro synon. sub *B. longifolia* Donn ex Dietr.

B. nervosa Filla, Flora 120, t.1 (1926), non (Meissner) Kuntze (1891). Nomen nudum.

B. praemorsa Dum.-Cours., Bot. Cult. ed. 2, 7: 107 (1814), non H. Andrews (1802). Insufficiently described.

B. procumbens Hort. ex Dum.-Cours., Bot. Cult. ed. 2, 7: 107 (1814). Nomen nudum, pro synon. sub *B. dentata*.

B. pubescens Hort. ex Dietr., Vollst. Lex. Gaertn. 2: 150 (1802); nomen nudum, pro synon. sub *B. longifolia* Donn ex Dietr.

B. reticulata Hoffsgg., Verz. Pfl. Nachtr. 2: 67 (1826). Insufficiently described.

B. rosmarinifolia G. Bennett, Wanderings in N. S. Wales, etc., 1: 108 (1834). Insufficiently described; possibly referable to *B. marginata* Cav.

B. rubra Hort. ex Dietr., Vollst. Lex. Gaertn. 2: 150 (1802); nomen nudum, pro synon. sub *B. longifolia* Donn

B. serratifolia Salisb., Prodr. 51 (1796). Insufficiently described. See discussion under 16. *B. aemula* R.Br.

B. tomentosa Hort. ex Dum.-Cours., Bot. Cult. ed. 2, 7: 107 (1814), non Forster & Forster f. (1775); nomen nudum, pro synon. sub "*B. littoralis*, Hort. angl."

B. tomentosa F. Muell., Hooker's J. Bot. Kew Gard. Misc. 8: 327 (1856); nomen nudum; from the region of the Victoria River, Northern Territory, and therefore probably referable to *B. dentata* L.f.

B. tomentosa Hort. ex Meissner, in DC. Prodr. 14: 454 (Oct. 1856), nomen nudum pro synon. sub *B. littoralis* R.Br. (? following Dum.-Cours.).

B. villosa Hort., in Roemer & Schultes, Syst. 3: 444 (1826), nomen nudum.

B. virens Don ex Roemer & Schultes, Mantissa, 3: 292 (July-Dec.1827); nomen nudum.

Sirmuellera serratifolia (Salisb.) Kuntze, Rev. Gen. Pl. 2: 582 (1891).

Excluded Names

Names published in *Banksia* but not referable to *Banksia* L.f. Except as otherwise indicated, all are referable to *Pimelea* Gaertn.

B. abyssinuica Bruce ex Steudel (1841) = *Hagenia*
B. alpina (Meissner) Kuntze (1891)
B. altior (F. Muell.) Kuntze (1891)
B. ammocharis (F. Muell.) Kuntze (1891)
B. angustifolia (R.Br.) Kuntze (1891)
B. argentea (R.Br.) Kuntze (1891)
B. axiflora (Meissner) Kuntze (1891)
B. bowmanii (Benth.) Kuntze (1895)
B. brachyphylla (Benth.) Kuntze (1891)
B. brevifolia (R.Br.) Kuntze (1891)
B. ciliata Dombey ex DC., nom. nud. (1828) = *Cuphea*
B. cinerea (R.Br.) Kuntze (1891)
B. clavata (Labill.) Kuntze (1891)
B. collina (R.Br.) Kuntze (1891) non R.Br. (1810)
B. coloratis (Meissner) Kuntze (1891)
B. concreta (F. Muell.) Kuntze (1891)
B. coruucopiae (Vahl) Kuntze (1891)
B. curviflora (R.Br.) Kuntze (1891)
B. dactyloides Gaertner (1788) = *Hakea*
B. drupacea (Labill.) Kuntze (1894)
B. elachantha (F. Muell.) Kuntze (1891)
B. eyrei (F. Muell.) Kuntze (1891)
B. ferruginea (Labill.) Kuntze (1891)
B. filiformis (Hook.f.) Kuntze (1891)
B. flava (R.Br.) Kuntze (1891)
B. floribunda (Meissner) Kuntze (1891) non Drummond (1849)
B. forrestiana (F. Muell.) Kuntze (1891)
B. gibbosa Smith (1790) = *Hakea*
B. glauca (R.Br.) Kuntze (1891) non Cav. (1800)
B. glutinosa Dombey ex DC., nom. nud. (1828) = *Cuphea*
B. guidia Forster & Forster f. (1776)
B. haematostachya (F. Muell.) Kuntze (1891)
B. heterophylla Colla (1824) ? = *Hakea*
B. hirsuta (Meissner) Kuntze (1891)
B. hispida (R.Br.) Kuntze (1891)
B. holroydii (F. Muell.) Kuntze (1891)
B. humilis (R.Br.) Kuntze (1891)
B. imbricata (R.Br.) Kuntze (1891)
B. latifolia (R.Br.) Kuntze (1891) non R.Br. (1810)
B. lehmanniana (Meissner) Kuntze (1891)
B. leptospermoides (F. Muell.) Kuntze (1891)—as *leptospermodes*
B. leptostachya (Benth.) Kuntze (1891)
B. ligustrina (Labill.) Kuntze (1891)
B. linifolia (Smith) Kuntze (1891)

B. longiflora (R.Br.) Kuntze (1891)
B. longifolia (Meissner) Kuntze (1891) non Dietr. (1802)
B. maxwellii (Benth.) Kuntze (1891)
B. microcephala (R.Br.) Kuntze (1891)
B. multiflora Anonymous (1800) = *Petrophile*
B. milligauii (Meissner) Kuntze (1891)
B. musculiformis Gaertner (1788) = Asclepiadaceae
B. nervosa (Meissner) Kuntze (1891)
B. nivea Labill. (1800) = *Dryandra*
B. nivea (Labill.) Kuntze (1891) non Labill. (1800)
B. octophylla (R.Br.) Kuntze (1891)
B. oleaefolia Salisb. (1796) = *Hakea*
B. pauciflora (R.Br.) Kuntze (1891)
B. petraea (Meissner) Kuntze (1891)
B. petrophila (F. Muell.) Kuntze (1891)
B. phylicoides (Meissner) Kuntze (1891)—as *phylicodes*
B. physodes (J. D. Hooker) Kuntze (1891)
B. pinifolia Salisb. (1796) = *Hakea*
B. pinnata Hort. ex Roemer & Schultes (1826) = *Hakea*
B. preissii (Meissner) Kuntze (1891)
B. proprata Dietr. (1802) in error, = seq.
B. prostrata Forster & Forster f. (1775)
B. puuicea (R.Br.) Kuntze (1891)
B. pygmaea (Meissner) Kuntze (1891)
B. pyriformis Gaertner (1788) = *Xylomelum*
B. rosea (R.Br.) Kuntze (1891)
B. sanguinea (F. Muell.) Kuntze (1891)
B. sericea (R.Br.) Kuntze (1891)
B. sericostachya (F. Muell.) Kuntze (1891)
B. serpyllifolia (R.Br.) Kuntze (1891)
B. simplex (F. Muell.) Kuntze (1891)
B. spathulata (Labill.) Kuntze (1891)
B. spectabilis (Lindley) Kuntze (1891)
B. spicata (R.Br.) Kuntze (1891) non Gaertn. (1788)
B. spiculigera (F. Muell.) Kuntze (1891)
B. stricta (Meissner) Kuntze (1891)
B. sulphurea (Meissner) Kuntze (1891)—as *sulfurea*
B. sylvestris (R.Br.) Kuntze (1891)
B. tenuifolia Salisb. (1796) = *Hakea*
B. teretifola Salisb. (1796) = *Hakea*
B. tinctoria (Meissner) Kuntze (1891)
B. tomentosa Forster & Forster f. (1775)
B. trichostachya (Lindley) Kuntze (1891)
B. tridentata (Meissner) B. D. Jackson (1895) = *Dryandra*
B. villifera (Meissner) Kuntze (1891)

Acknowledgments

My early interest and study in *Banksia* was encouraged and assisted by the late Charles Gardner under whom I worked for a year on joining the Western Australian Herbarium in 1959. Two collectors who kindled the flame in those days were the late Fred Humphreys and Charlie Davies. Mrs. Evelyn Humphreys has continued to take a close interest in the study. Mr. Bob Royce, Curator at PERTH from 1960 to 1974, provided the early support and guidance that are needed in a long-term project. In the early 1970s Lawrie Johnson and Don McGillivray urged me to expand beyond the Western Australian border to include the eastern species in the revision; they and other colleagues at the National Herbarium of New South Wales have since readily assisted with field work and discussion. Further assistance with field work in the east was given by Geoff Stocker (Atherton), Betsy Jackes (Townsville), Selwyn Everist (Brisbane), Elma Reilly (Sydney), Alex Blomberry (Sydney), Trevor Hawkeswood (Townsville) Alf Salkin, Sue and Rex Filson, Celia Rosser and George Scott (Melbourne), Colin and Dorothy Woolcock (Portland), Denny King (south western Tasmania) and Ron Crowden (Hobart). Clyde Dunlop (Darwin) collected mature seed of *Banksia dentata*.

In Western Australia I have had much assistance and discussion from the staff of the Western Australian Herbarium, especially Paul Wilson. The librarian, Marion Wickham, sought out many references. Collections and field data here have been augmented by Clem Burns (Geraldton), Charles Chapman (Winchester), Stephen Hopper (Wildlife Research Centre, Wanneroo), Terry Wilson (Perth), Spike Daniels (Albany), Alison Harrington (Perth), Nancy Verco (Esperance), Ray Garstone (Woodanilling), Hazel Dempster (Manjimup), Ted Griffin (Perth), Basil and Mary Smith (Manmanning), Ken Newbey (Ongerup), Ernst Wittwer (Kings Park) and Peter Luscombe (Narrikup).

John Maconochie (Alice Springs), Bruce Maslin (Perth), Munir Ahmad Abid (Adelaide) and Ian Brooker (Canberra) assisted in various ways during their respective terms as Australian Botanical Liaison Officer at the Royal Botanic Gardens, Kew. Arthur Chapman (Canberra) provided very useful advice on bibliographic aspects.

Outside Australia I have been greatly assisted by the staff of the herbarium and library both at the Royal Botanic Gardens, Kew, and at the British Museum (Natural History). John Rourke (Kirstenbosch) gave advice during the search for data on Salisbury and his work.

The Directors of the following herbaria lent material for study: AD, B, BM, BRI, CANB, CBG, CGE, E, FI, G, HO, JCT, K, L, LD, MEL, Monash University, NBV, NSW, NT, OXF, P, QRE, S, TUB, US, W. I also thank the staff of the following herbaria for assistance during visits: AD, BRI, CANB, CGE, E, FI, G, HO, LINN, MEL, NSW, NY, P, QRS, US.

At the Western Australian Herbarium the technical assistance essential to handling the large amount of material studied was cheerfully provided by Karen Barker, Wendy Lee-Frampton, Cheryl Lynch and Gail Frost. The draft manuscript was typed by Vicki Hamley, Janice Rooke and John Eygenraam, with the final copy by typists of the Department of Agriculture's Word Processing Centre under the guidance of Phyllis Fry.

Two grants were received from the Australian Biological Resources Study, one in 1974 to allow the employment of a techical assistant (in particular to curate the carpological collection of *Banksia* at PERTH, estimated to contain about 1 000 collections); the second in 1975 to support an expedition to eastern Australia when I was able to study all taxa there in the field.

The line drawings of fruit were carefully prepared by Sharon Genovese.

My family has variously enjoyed and endured *Banksias*, in many places, at many times, but always with interest.

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Addendum

In June 1981, excellent flowering and fruiting material was received of the *Banksia* first collected by Dallachy in 1867 and 1868 and discussed on page 280 above. The specimens were gathered on Hinchinbrook Island, Queensland, by Arthur and Margaret Thorsborne and M. Godwin. They show that the taxon is a good species and it is described here.

Banksia plagiocarpa A. S. George, sp. nov.

Frutex expansus ad 5 m altus; truncus ad 30 cm. diam; cortex grosse fissurata. *Folia* sparsa sed ad apices ramulorum conferta, anguste lanceolata ad angustissime obovata, 8–20 cm longa, 6–17 mm lata, marginibus recurvis obtuse serratis vel integris; surculi novi dense tomentosi, ferruginei. *Inflorescentia* cylindrica, 7–14 cm longa, 5–6 cm diam. *Alabastra* caesia vel glaucescens; styli pallide flavi. *Perianthium* 22–25 mm longum limbo 4–5 mm longo includens, extus appresso-pubescens, intus glabrum. *Pistillum* 26–28 mm longum; stylus glaber; pollinis praebitor angustus, 0·5–0·7 mm longus. *Infructescentia* crassa, floribus veteribus deciduis. *Folliculi* 12–16 mm longi, 5–10 mm alti, 5–8 mm lati, valvis triangularibus margine antistylari longiori curvato, arcte tomentosis deinde glabris. *Semina* obovata margine superiori oblique curvato, 15–17 mm longa; seminis corpus obovatum, 8–9 mm longum, 3–4 mm latum.

Type: N slope of Mt Bowen, Hinchinbrook Is., Queensland, in 18° 20′S, 146° 15′E, 15 June 1981, *A. & M. Thorsborne* and *M. Godwin* C1833. Holo: BRI; iso: CANB, K, NSW, PERTH.

Derivation of name. From the Greek *plagios*, sloping or oblique, and *carpos* a fruit; the obliquely triangular follicles that are slightly upturned are a distinctive feature of the species.

Mature plant a shrub to 5 m tall with a spreading crown sometimes reaching base. *Trunk* to 30 cm diam. *Bark* coarsely fissured, corky, greyish-brown. *Branchlets* at first slender, 2–3 mm diam., densely tomentose with ferruginous-red curled hairs, becoming grey, glabrous after 2 or 3 years; prophylls widely scattered along lower part of branchlet, linear, obtuse, 2–10 mm long, densely tomentose, deciduous. *Leaves* scattered mostly crowded towards apices of branchlets, narrowly lanceolate to very narrowly obovate, obtuse, sometimes almost emarginate, 8–20 cm long, 6–17 mm wide; margins recurved, obtusely serrate to entire, the teeth 1–3 mm long; sinuses shallow, oblique, mostly 5–15 mm wide; midrib impressed above, prominent below; lateral nerves mostly at 80 –90° to midrib, forked before margin, reticulate between; all nerves densely tomentose with ferruginous hairs, becoming glabrous; lacunae white-woolly; upper surface of lamina densely tomentose, ferruginous, becoming glabrous soon after maturity; petioles 5–20 mm long. *Inflorescence* terminal to a 1–2-year-old branchlet, often subtended by whorl of lateral branchlets, cylindrical, 5–6 cm diam. at anthesis. *Inflorescence bracts* linear-terete on thick bases, obtuse, 2–8 mm long, closely tomentose, the hairs slightly longer towards bract apices, ferruginous, some persistent to fruit. *Axis* 7–14 cm long, 5–7 mm wide, 15–17 mm wide with common bracts, without flowers for up to 1 cm at base. *Common bracts* linear, 5–7 mm long, densely hirsute, the exserted apex conical, straight, almost acute, densely and closely tomentose, ferruginous-red with extreme tip paler. *Floral bracts* similar but slightly narrower, shorter and with exserted apex rounded. *Flowers* rather openly arranged, without evident pattern at anthesis; buds at first creamy-grey, becoming pale bluish-grey to mauve before anthesis, the limb pale pink-brown in upper half; style pale yellow with brown pollen-presenter. *Perianth* 22–25 mm long including limb of 4–5 mm, straight with the limb somewhat upturned at anthesis; claws 0·4–0·5 mm wide at base, slightly tapering, appressed-pubescent outside with silvery-white hairs, glabrous inside; limb narrowly fusiform, almost acute, obtusely keeled, appressed-pubescent or almost hirsute outside, glabrous inside. *Anthers* 1 mm long, shortly apiculate, on filaments 1 mm long. *Pistil* 26–28 mm long, straight or gently curved; style glabrous; pollen-presenter cylindrical but slightly swollen and wrinkled at base, scarcely thicker than style, obtuse, 0·5–0·7 mm long, the stigmatic groove oblique at apex; ovary shortly hirsute about apex, otherwise glabrous. *Hypogynous scales* linear to narrowly triangular or obovate, obtuse or acute, 1·5 mm long, free. *Infructescence* ovoid, stout, 4–5 cm diam.; old perianths and styles soon deciduous; common and floral bracts enlarged, indurated, the common bracts almost pungent. *Follicles* up to 60, in plan view narrowly

elliptic but somewhat turned upwards, 12–16 mm long, 5–10 mm high, 5–8 mm wide; valves ± triangular but antistylar margin the longer and curved, obtuse, gently convex, smooth, closely tomentose becoming glabrous where exposed; some follicles opening after 1–2 years, others remaining closed; when open, up to 15 mm across; lips 1 mm wide, almost even; no lateral beak. *Seed* obovate but upper margin obliquely curved, 15–17 mm long, a shallow angle at stylar point; seed body obovate with stylar side straight, 8–9 mm long, 3–4 mm wide, obtuse at base; inner face flat to convex, slightly rugose, black-brown, glistening; outer face obtusely ridged to almost flat, ± smooth, dark brown, shining; wing 8–9 mm wide. *Separator* similar to seed in outline and size, but 9–10 mm wide.

Distribution. Queensland, restricted to Hinchinbrook Island and the adjacent mainland.

Selected collections. Coast Range (near Rockingham Bay), 21 Feb. 1868, *Dallachy* s.n. (K, MEL); N slope of Mt Bowen, Hinchinbrook Is., *A. & M. Thorsborne* and *M. Godwin* 1831 (BRI, JCT).

Habitat. In sandy loam or clay-loam on rocky (granite) slopes in closed shrubland and low woodland, with *Casuarina*, *Syncarpia*, *Xanthorrhoea*, *Leptospermum*, etc.; altitude 270–530 m.

Flowering period. Flowers recorded in January and June.

Banksia plagiocarpa belongs to the series *Salicinae* of the section *Banksia*, and in the systematic arrangement used in this paper should be placed before 7. *B. oblongifolia Cav.* It is distinguished especially by the bluish-grey buds and the obliquely triangular follicles. It is closely related to *B. oblongifolia*, from which it differs further in the short, stout trunk and in the longer, serrate to entire leaves; that species is often somewhat bluish-grey in bud, but not as much so as in *B. plagiocarpa*. Another relative is *B. integrifolia* L.f. var. *aquilonia* A. S. George which is a small, erect tree with narrower leaves, yellow flowers, and fruit that open within a year of flowering; it occurs on Mt Bowen close to the new species.

In the key to species, a specimen of *B. plagiocarpa* with entire leaves runs down to lead 67a (*B. integrifolia* var. *aquilonia*) and can be distinguished by the characters mentioned above. If the specimen has serrated leaves it runs to lead 84a and can be separated from the three taxa which key out through leads 85 and 86 by its longer leaves.

Plants of *B. plagiocarpa* have short, stout trunks with fissured, corky bark, and are probably fire-tolerant, sprouting by epicormic shoots after a burn.

The assistance of Arthur and Margaret Thorsborne of Cardwell, and M. Godwin of the National Parks and Wildlife Service, Cairns, is gratefully acknowledged. Their collections of *Banksia plagiocarpa* contained flowers, fruit and new growth, and were accompanied by detailed notes.

Corrigenda

page

264 Para. 3, line 2. *For* has *read* have

269 Lead 5a. *For* cm *read* mm

274 Lead 89a. For *A.* read *B.*

276 Line 20. *For* 31–46 cm *read* 31–46 mm

284 Latin description, line 6. *For* versis *read* versus Lines 7, 10. *For* + *read* ±

292 Under *B. marginata* var. *humilis*, line 2. *For* his var, *read* his var. 8

301 Under *B. latifolia* var. *minor*, line 4. *For* N.S.W. *read* NSW
Under *B. salicifolia*, line 2. *For* piri-formis *read* piriformis

302 Habitat, line 1. *For* seasonably *read* seasonally

304 Line 1. For *Banksia oleaefolia* read *Banksia oleaefolia* Salisb.

306 Para. 1, line 5. *For* + *read* ±

307 Line 10. *For* 3/4 *read* 3–4

311 Para. 1, line 7. *For* 25 *read* 15
Last para., line 16. *For* 5–6 cm *read* 5–6 mm

312 Para. 6, line 2. *For* obtuse leaves *read* obtuse lobes

318 Para. 1, line 4. *For* lamna itapering *read* lamina tapering

323 Para. 6, line 12. *For* 18–25 wide *read* 18–25 mm wide

338 Last para., line 17. *For* 7–15 mm *read* 7–15 cm

342 Para. 2, line 4. *For* 4–5 mm *read* 4–5 cm
Para. 3, line 17. *For* including *read* 12–16 mm wide with
Para. 3, line 19. *For* 2 mm *read* 4–5 mm

344 Para. 1, line 16. *For* 8–10 cm *read* 8–10 mm

356 Para. 2, line 2. *For* 0·5 mm *read* 5 mm

358 Para. 1, line 2. *Add at end of line* higher leaves

359 Under **Banksia audax**, *delete* 24 Oct. *from date.*

360 Para. 1, line 9. *For* nucellus *read* seed body

361 Para. 1, lines 10, 11, 14, 15. *For* var. *read* subsp.

362 Last line. *For* motsly *read* mostly

367 Latin diagnosis, line 3. *For* rubescens *read* erubescens

368 Last para., line 13. *For* braced *read* bracts
Last para., line 14. *For* exsertts *read* exserted

369 3rd last para., line 4. *For* and *read* at

370 Para. 1, line 16. *For* 17–26 *read* 21–26

375 Last para., line 1. *For* prostrate stems *read* lignotuber

382 Para. 3, line 9. *For* 6–8 mm *read* 6–8 cm

389 2nd last para., line 4. *For* triparte *read* tripartite

392 Last para., line 2. *For* 5 *read* 6

393 Para. 1, line 4. *For* 3–12 mm long, 1·8 (11) mm *read* 3–12 cm long, 1–8(11) mm
Para. 1, line 25. *For* 30·45 *read* 30–45

396 Last para., line 1. *For* 5 *read* 6

The following names were inadvertently omitted from the main text.

Banksia integrifolia L.f. var. *dentata* Meissner, in DC., Prodr. 14: 457 (1856); based on *B. macrophylla* Link, = *B. robur* Cav.

Banksia marcescens [R.Br.] var. *praemorsa* (Andrews) Colla, Hort. Ripul. 18 (1824), = *B. praemorsa* Andrews.

Banksia marginata Cav. var. *diffusa* Endl., Gen. Pl. Suppl. 4, 2: 88 (1848). Nomen nudum, = *B. marginata* Cav.

Banksia marginata Cav. var. *microstachya* (Cav.) Sims, Bot. Mag. 45: t. 1947 (1818); based on *B. microstachya* Cav., = *B. marginata* Cav.

Banksia microstachya Cav. var. *marginata* (Cav.) Domin, Biblioth. Bot. 89:44 (1921); based on *B. marginata* Cav.

Banksia oblongifolia Lodd., Lodd. Bot. Cab. 3:t.241 (1818).
Although Loddiges citcd no author for the name, this is evidently *B. oblongifolia* Cav.

Banksia prostrata Sweet, Hort. Brit. edn 1:350 (1827), non Forster & Forster f. Nomen nudum et dubium.

Banksia serrata L.f. var. *latifolia* Raf., Autik. Botanik. 142 (1842). Nomen dubium; insufficiently described.

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Numerals in bold type represent entries of accepted names.

Names in bold type are new taxa described in this account. Names in italics are synonyms, nomina dubia or excluded names. Names in roman are accepted names.

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